POPULAR SCIENCE

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SM

WEIRD ENGINE HUNTS GOLD ON OCEAN FLOOR

Page 54

IT COST BILLIONS OF DOLLARS TO BUILD

YET YOU CAN USE IT FOR A FEW CENTS A DAY

EVERY TIME you telephone you share the benefits of a nation-wide communication system using eighty million miles of wire and employing four hundred thousand people. It represents a plant investment of more than four thousand million dollars, yet you can use a part of it for as little as five cents . . . for considerably less on a monthly service basis.

The organization that makes efficient telephone service possible is called the Bell System, yet it is as truly yours as if it were built specially for you. For every telephone message is a direct contact between you and the person you are calling.

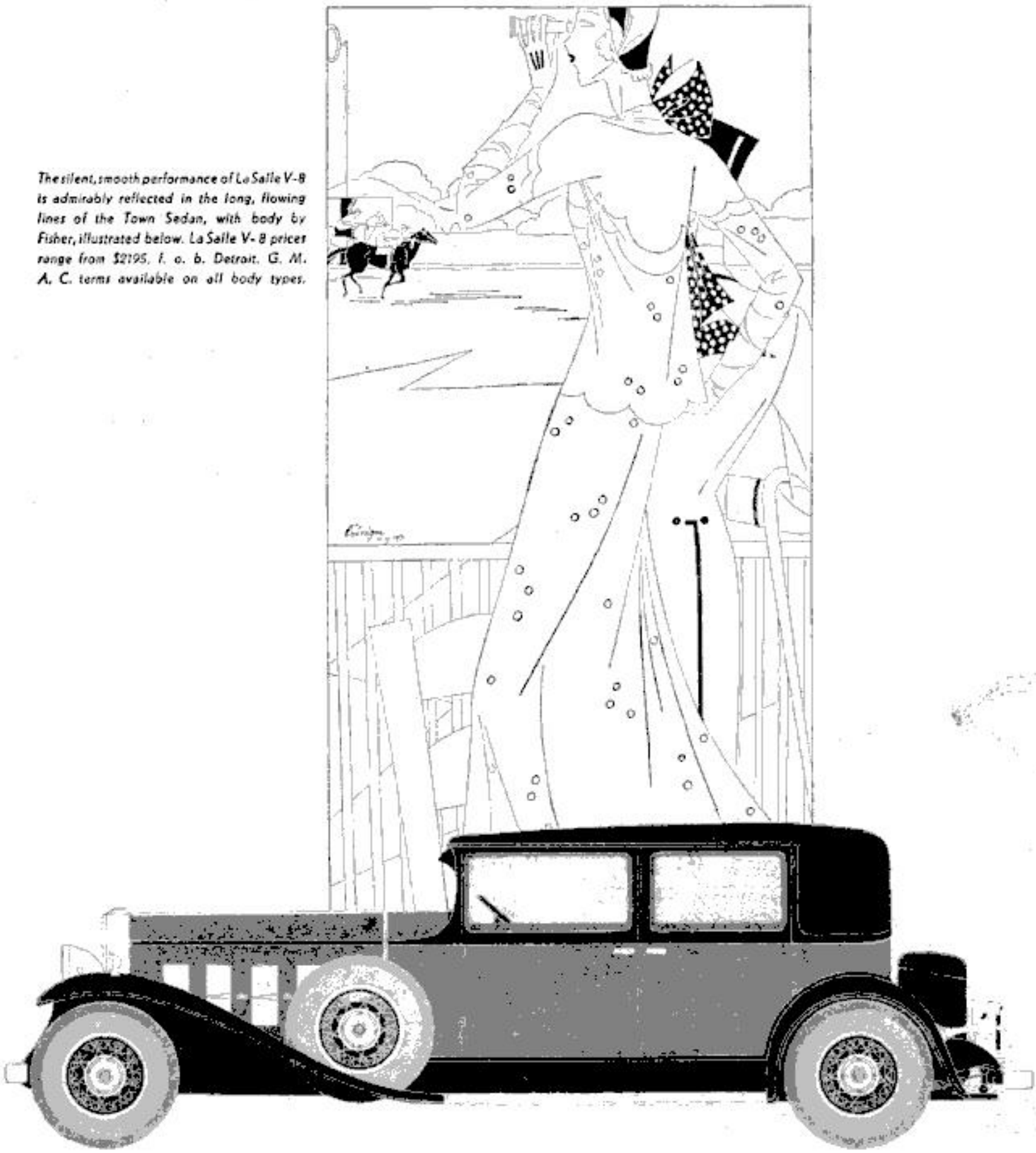
At any hour of the day or night, the telephone stands ready and waiting to carry your voice to any one of twenty million other telephone users in this country. It knows no rest or sleep, or class or creed. All people—everywhere—may use it equally. Its very presence gives a feeling of security and confidence and of nearness to everything. Many times during the day or week or month, in the ordinary affairs of life and in emergencies, you see the value of the telephone and realize the indispensable part it plays in every business and social activity.

The growth of the Bell System through the past fifty-five years and the constant improvement in service may well be called one of the great achievements of this country. Greater even than that are the policies, improvements and economies that make this service possible at such low cost.

Of all the things you buy, probably none gives so much for so little as the telephone.

★ *AMERICAN TELEPHONE AND TELEGRAPH COMPANY* ★

The silent, smooth performance of La Salle V-8 is admirably reflected in the long, flowing lines of the Town Sedan, with body by Fisher, illustrated below. La Salle V-8 prices range from $2195, f. o. b. Detroit. G. M. A. C. terms available on all body types.



In creating such mechanical masterpieces as the V-12 and the V-16, Cadillac engineers and craftsmen blazed their own trails of design and manufacturing methods. In fashioning bodies appropriate for such chassis, Fisher and Fleetwood artists achieved coachwork of singular beauty and charm. Many original and valuable developments have resulted—and from them, the La Salle V-8, companion to the gifted Cadillacs, has profited handsomely. Yet the La Salle, despite its rich heritage and distinguished bearing, costs little more than many an ordinary car.

LA SALLE V-8

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POPULAR SCIENCE MONTHLY

381 Fourth Avenue
New York, N. Y.

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September, 1931, Vol. 119, No. 3. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1931, by the Popular Science Publishing Co., Inc. Single copy, 25 cents. Nine months' subscription, $2. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. In presenting numerous stories of the new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized. A. L. Cole, President and Treasurer; R. C. Wilson, Vice-President; John Nichols, Vice-President; F. W. Briggs, Secretary.

Popular Science Monthly for September, 1931

MAKING $36. *a Month* GROW *into* $20,000.

By LEON MEADOW, *Financial Editor*

ONE Sunday morning, after dropping their respective children at Sunday School, Ned Chadwick and Arthur Perkins set off for home, walking, and discussing their finances, savings, prospects, etc. "Have you ever thought about building and loan shares as a means of accumulating a good sum of money in the fastest, safest way," asked Chadwick.

"Oh, very rarely—it's too small a savings scale to be considered seriously."

"Too small? You poor sap! It's probably one of the best ways offered to average men, like you or me, for building up a sizeable estate. What do you know about it, anyway?"

Perkins laughed. "You save $1.00 a month for Lord knows how many years, and then suddenly you have $200. Well, what of it? $200 may look big to me right now, but viewed from a five or ten year perspective, it gets to be very small. I need a bigger plan to put me on the right road."

"All right, Mr. Knowitall, I'll put the question another way. Can you afford to save an average of $36 a month for the next 22 years?"

"I suppose I could,.. Arthur replied, "but there would have to be some mighty good inducement in doing it."

"Boy," Ned exclaimed, "there's plenty of *that!* $20,000 in actual cash!"

"$20,000," Arthur half shouted. "You don't mean $20,000 from building and loan shares. It's out of the question."

"Is it?" Ned answered smiling, as they turned the corner of the block where both men lived. "Come up to the house and I'll show you how it works—in cold figures."

They walked into the house, and Ned went over to his desk and picked up the chart reproduced below.

"Yesterday I happened to meet a chap from the local building and loan association," Chadwick said. "He mapped out this entire program for me—and I'm going to start following it right away."

Perkins looked at the chart. "Figures don't mean much to me. You'd better explain it to me in words."

"All right," Chadwick replied. "Building and loan shares mature in a little more than 11 years, on the average. We took an even 11 years to make it easier in working this thing out. The unit is $1.00 per share per month—and the unit return for this is $200 at maturity. In this plan you begin by carrying 5 shares the first year, and adding 5 shares more each year for 11 years. In the third column you will see what you must save each year to do this. Then, in the 12th year you decide to carry 100 shares. Also, in this year the 5 shares you started the 1st year, mature—bringing you $1,000. Now you are carrying 150 shares in all—50 shares remaining from the first 11 years and 100 shares started the 12th year. So you must save $150 a month to carry this. Now split that $1,000 received from the maturity of the first 5 shares, into twelve equal parts of $83 each—and apply each one of these $83 parts against monthly payments for this year. So you actually have to save only $67 as the next to last column will show. In the 13th year, the 5 shares started the 2nd year mature, bringing you another $1,000—and leaving you only 145 shares to carry that year. Split this $1,000 into 12 equal $83 parts again—and apply it against the $145—leaving you $62 to be saved each month in this year. Do you follow me?"

"I do, and I also see how it works every year down to the 22nd, when only 100 shares are left—and then they too mature."

"Exactly," Ned continued. "And that 100 shares will bring you $20,000—on an average building and loan rate of interest. Your actual principal invested is $9,504—and your interest is more—$10,496 to be exact! Does that impress you, Mr. Perkins?"

"Well, Mr. Chadwick," said Arthur, grinning broadly, "it might have impressed me a few minutes ago, but it just occurred to me that money in the bank doubles itself in about 17 years, whereas you've taken 22 years to do it. Where's the percentage?"

"You're even dumber than I thought you

1st to 11th Years

YEARS	Monthly Savings @ $1 a share	Yearly Savings
1st	$5	$60.00
2nd	10	120.00
3rd	15	180.00
4th	20	240.00
5th	25	300.00
6th	30	360.00
7th	35	420.00
8th	40	480.00
9th	45	540.00
10th	50	600.00
11th	55	660.00
		$3,960.00

12th to 22nd Years

YEARS	Shares maturing each year	Value by year and month	No. of shares now remaining	Additional shares carried	Total Shares Carried	Total to be saved less income on matured shares	Total yearly savings
							1st 11 years $3960.00
12th	5	$1,000-$83	50	100	150	$67.00	804.00
13th	5	" "	45	——	145	62.00	744.00
14th	5	" "	40	——	140	57.00	684.00
15th	5	" "	35	——	135	52.00	624.00
16th	5	" "	30	——	130	47.00	564.00
17th	5	" "	25	——	125	42.00	504.00
18th	5	" "	20	——	120	37.00	444.00
19th	5	" "	15	——	115	32.00	384.00
20th	5	" "	10	——	110	27.00	324.00
21st	5	" "	5	——	105	22.00	264.00
22nd	5	" "	——	——	100*	17.00	204.00

*VALUE OF 100 SHARES REMAINING IS $20,000.00 actual savings $9504.

were! Of course money doubles itself under those conditions—BUT, only on the actual sum deposited the very first day you start. In this case, you'd have started by depositing $10,000 in a bank today to get back $20,000 in 17 years."

"I never thought of that. Even so, how does this sum compare with the same total amount deposited in a savings bank?"

"I asked that fellow the same question, yesterday. He said they had figured out that $36 deposited every month for 22 years in a bank @ 4¼% compounded quarterly would mount to $15,660 in that time."

"You mean building and loan nets you $4,400 more!" Arthur exclaimed. "That certainly makes it even more attractive. The interest rate must be higher. Is it as safe?"

"It is, if it's a well established and well managed institution, just as a savings bank is, under similar conditions. Honestly and sensibly directed, building and loan associations can earn a legitimately high rate of interest from their transactions, which are confined to lending on first mortgages to people owning or building their own homes.

"The thing I like best about this plan is the distribution of the savings load. At the beginning it's small. For instance, you're 28 now. At 42—probably your best year from an income standpoint—the load reaches its peak, and declines thereafter, easing the burden of the coming years considerably. Building and loan plans urge and make an inducement of systematic savings that you don't like to touch. In a bank, voluntary deposits too often make for voluntary withdrawals."

Arthur grinned. "You win, hands down. If you don't see me at lunch tomorrow, it's because I have a date with that man from the building and loan association."

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

Your Income and Your Life Insurance is the name of a brief booklet scientifically answering the question "How much life insurance does a man really need?" Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

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POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

THE PUBLISHERS

Grammar At a Glance

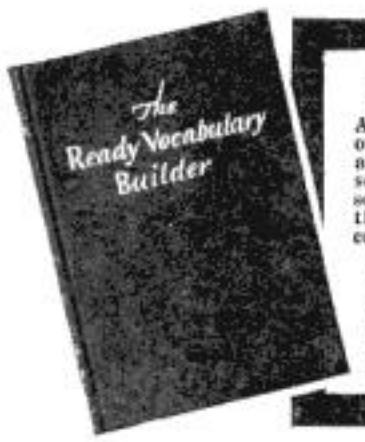
A new and unique method for simplifying English grammar and giving you an easy understanding of its essentials. The same demonstration sentence with slight variations, is used throughout to illustrate the eight parts of speech and their correct use. A practical self-testing system is included. It is an amazingly simple and effective method and will surprise you with its ease and simplicity. At last English grammar is made easy.

Common Errors In English Corrected

The authors have tabulated the errors in English that are most likely to trip you up. They point out the error and explain the correct form. You will be delighted to see what great progress you can make in polishing up your speech and writing with this book, and how easily you can save yourself from the embarrassing bad English that mars your speech and handicaps you in all your associations.

A Guide to Good Pronunciation

Thousands of the words most frequently mispronounced are listed here with correct pronunciations. For each word a guide to correct pronunciation in the form of simple words with the same sounds is given to make it easier than ever before to learn good pronunciation. An hour with this book will probably correct dozens of mispronunciations of which you are now unconscious but which hurt you with others.

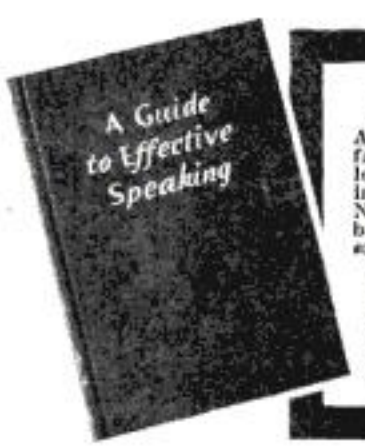


The Ready Vocabulary Builder

A remarkably helpful book with over six thousand synonyms and antonyms. They are presented with *examples of use* so that you grasp fully the distinctions in meaning and the correct use of each word. This book will rapidly build your vocabulary and give your speech and writing more power, color, exactness. It will give you that valuable ability to use the *right* word in the *right* place.

A Guide to Effective Writing

Quick and useful information on every form of writing—business, social, literary. We are all writers in one way or another and we all need facility in writing. The knowledge of what makes writing effective, that is so plainly and thoroughly explained here, will prove of enormous dollars and cents value to you whenever you undertake the task of writing anything.



A Guide to Effective Speaking

A veritable encyclopaedia of facts on all the practical problems of speaking, formal or informal, business or social. No one who understands the basic principles of speaking explained clearly here need feel any hesitation or embarrassment when called upon to express his ideas in a conference or interview, on a platform or the speakers table in a social group, or anywhere else.

Here's Your Good English Tool Chest

A new way to clear up your English troubles—to make you a master of good English—is offered in the most practical and usable series of handy volumes ever prepared. Here are six Rapid Guides to Good English that will appeal immediately to the practical person who doesn't want school-room exercises or long-drawn-out discussions but clear, brief, easily grasped facts about the correct use of English.

Good English Opens the Way To Good Fortune

It is the man who can express himself well—whose mastery of English enables him to present his ideas effectively—who captures the richest prizes in any line of work or any social circle. To be able to speak well, write well, converse well, present your ideas forcefully in conference or interview, is to put yourself in a position where opportunities come to you—and can be seized. Slip-shod English is a fatal handicap. It prevents many a man with real ability from winning the success he should have. Too often the capable business man, the talented mechanic, the well-trained professional man, is outstripped because he can not do justice to himself by expressing himself well to others and sees a man of smaller ability forge ahead of him. Beware of shabby speech and writing. Give your real ability its proper chance.

A New and Sensible Method for the Practical Man

It is not difficult to master good English if its study is undertaken with common sense. There has been a real need for this common-sense explanation of the subject—for a series of *Rapid Guides to Good English* that would meet the demands of daily life and give to busy people a quick, simple, usable survey of the essentials of correct usage. That need has now been met by this series of six convenient handbooks that give you all the facts you need to be a master of English. This series is neither too childish for practical value, nor too advanced for easy understanding. You are not warned against "I seen" and "You is," nor are you bored with technical abstractions. The series is intelligently planned to be intensely usable for practical people.

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A Handbook for Reference

This new series of six *Rapid Guides to Good English* has been prepared by a group of three practical, widely experienced instructors: P. T. Ward, Instructor in Business English at Columbia University and Lecturer in Business Correspondence, Metropolitan Life Insurance Co.; C. B. Anderson, Instructor in English, Columbia University; A. W. Riley, Lecturer in English, Columbia University. They have divided the whole subject of good English into its six natural classifications, and explained each of the six in a volume that is 100% usable. See the descriptions of the individual volumes to the left. The series as a whole has been related and unified. It represents the most valuable exposition of good English for the practical man that we, as publishers, have ever seen.

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Each one of the six books is based upon a definite, new, practical idea worked out to make the subject clear, its treatment useful, its mastery easy. You will see this immediately for yourself when you examine the books. So we want to put them into your hands for FREE EXAMINATION without obligation or expense to you. If you agree, when you see them, that they are the most helpful books on the subject you have ever seen, keep them, make a first payment of $1.95, and three monthly payments of $2.00—a total of only $7.95. If you do not want them, send them back and owe nothing. Don't let others have a better chance than you have. Give yourself the mastery of English that is essential to success.

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Careful plans must be made if you are to have the fullest heating comfort in your dwelling during the coming winter.

What Are Your Heating Plans?

By
COLLINS P. BLISS
Director of Popular Science Institute

MORE than seven cents of every dollar spent in building goes into the heating plant, it is estimated. Of each dollar spent for maintaining a home, including taxes, repairs and similar items, as much as fifty cents or more is often spent for fuel. Therefore it is extremely important for the home-builder to get the most he can from his money, remembering that it is much easier to plan a heating system properly before it is installed in his home than to remodel it afterward.

Every man must answer for himself the question of which house-heating system he will install—warm air, simple, foolproof, inexpensive to put in; steam, with its positive heat and low expense to install; vapor, cousin of steam, with quick economical heat and added ability to meet sudden changes in weather conditions; hot water, mild but effective with its mellow heat and economical to operate.

Vapor systems and hot-water systems probably would lead the list if price were no object, from the standpoint of service and flexibility. Yet the lower first expense of other systems is not the only argument in their favor. A warm-air system is also a highly flexible type. Then there is the question of humidity, easily supplied in a warm-air system; of the small radiators required in a steam system; and other factors.

In deciding what fuel to burn, the answer is much easier for it will be decided partly by local conditions and partly as a matter of service rendered versus expense. The choice should be made only after careful thought.

For the vast majority of American homes, coal is still the standard fuel, and when burned properly is highly satisfactory. Its use naturally entails a certain amount of labor; but at some extra expense, labor saving devices such as automatic stokers, or magazine boilers requiring less frequent firing are available.

While coal is still the standard fuel, oil heating has increased nearly 500 percent in five years, according to the U. S. Bureau of Mines, and now more than 400,000 American homes are heated by oil. The appeal of oil burning lies in the fact that it brings, in the best types of installations, fully automatic heat. A thermostat can keep the house at any desired temperature day after day without attention.

Compared with many solid fuels, oil is so clean that the cellar may be used for a living room. Moreover, oil heat bridges the interval between winter and the milder months when, even though it be for only two hours a day, the oil burner operates automatically and keeps the chill from the house. As to cost, burning oil is generally not excessive when all of its desirable features are considered. Due to individual differences in houses and the efficiency of their heating plants, it is sometimes cheaper.

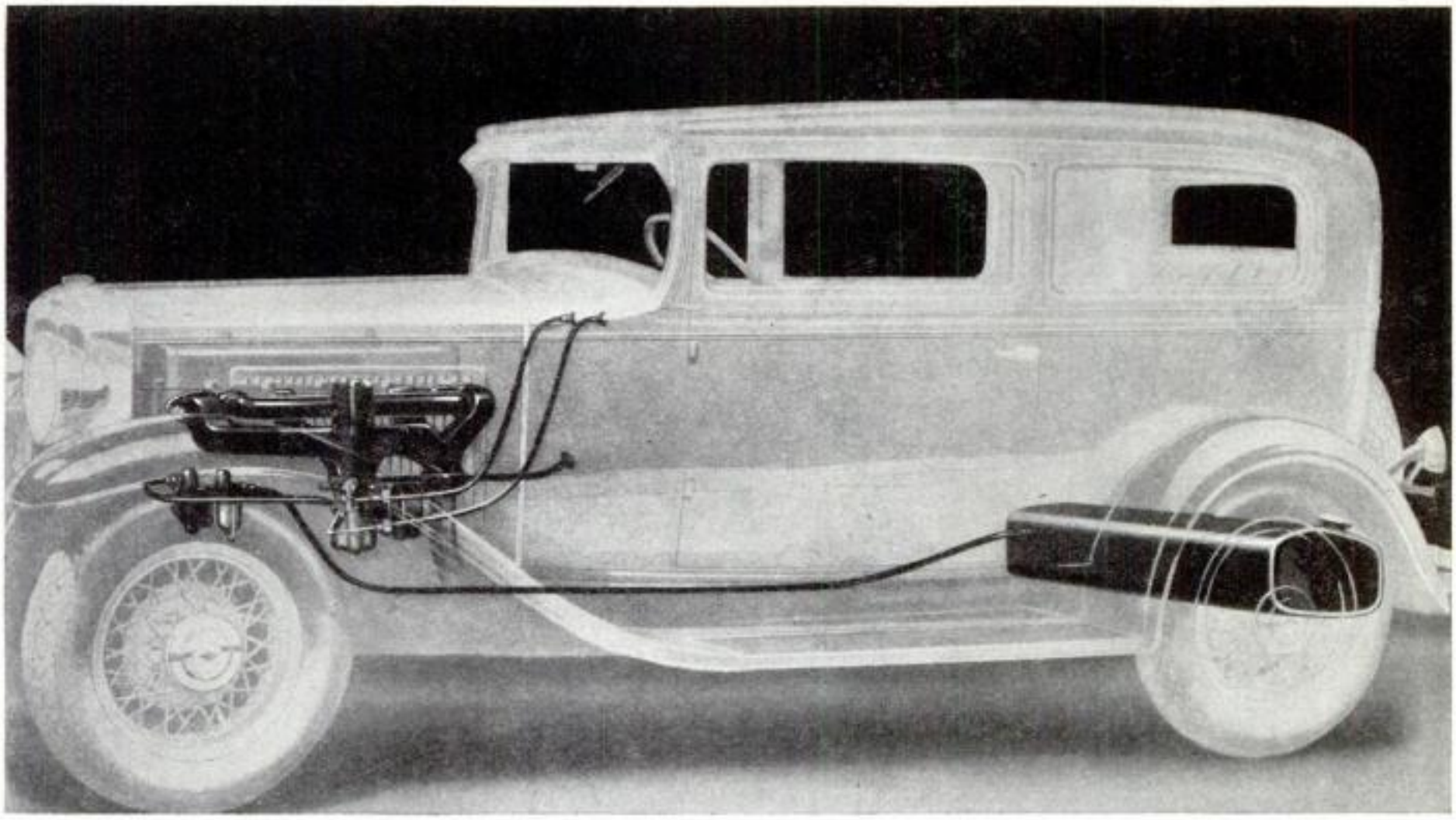
WITH gas heat, there are all the advantages of oil as well as other factors. Gas is the simplest form of heat, house heating with gas being hardly more elaborate than using it for cooking. An advantage over oil is that no arrangements are necessary for storing fuel; no deliveries are necessary. Also, gas is paid for *after* it is used. Considered in dollars and cents as a fuel, and disregarding the heating service it affords, gas is a more expensive type of heat, except where natural gas is easily available.

Readers who want additional information may present their problems to Popular Science Institute, or may secure much help from the booklet "House Heating and Ventilating" available at twenty-five cents a copy from Popular Science Institute, 381 Fourth Avenue, New York.

INSTITUTE BULLETINS

Heating and Ventilating*
Insulation in Building Construction*
List of Approved Tools
List of Approved Radio Sets
List of Approved Oil Burners
Advice on Installing Oil Heat
Refrigeration for the Home*

***Starred bulletins 25 cents**



CHEVROLET GASOLINE SYSTEM

combines many interesting modern devices

The gasoline system of the Chevrolet Six well repays careful study by everyone interested in engineering progress. The scientific devices making up this system represent the very latest advancements in fuel-feeding. In fact, the Chevrolet gasoline system, as a whole, is as safe, efficient and modern as that used on any car, regardless of price.

Chevrolet uses the modern "pump" method of fuel supply, accepted as standard practice by practically all automotive engineers. With this method the supply tank is mounted at the rear of the chassis, outside the body and away from the ignition system and engine heat—a vital safeguard for driver and passengers.

A modern fuel pump, equipped with a filter, forces the gasoline to the carburetor, and assures a positive flow of clean fuel at all engine speeds and on any incline.

The carburetor is specially designed for the Chevrolet six-cylinder engine and hot-spot manifold. It incorporates an accelerating pump, which delivers an extra charge of fuel when the throttle valve is suddenly opened from the idling position—assuring extra power when most needed.

Mounted on the carburetor's air-intake port is an AC combination air cleaner and flame arrestor. By removing dust from the air entering the carburetor, this device protects the polished cylinder walls from abrasion. The flame arrestor is a safety feature in case of backfire.

This modern gasoline system, reflecting as it does every recent major improvement in fuel-feeding, typifies Chevrolet's advanced design. To provide greater safety, economy and efficiency throughout the car, Chevrolet engineers have utilized many other equally interesting devices. What they are can be quickly learned from your Chevrolet dealer. He will be glad to have you examine and drive this high-quality, low-priced six-cylinder car.

Chevrolet prices range from $475 to $650, f. o. b. Flint, Michigan. Special equipment extra. Chevrolet Motor Company, Detroit, Michigan

NEW CHEVROLET SIX

The Great American Value

Our Readers Say

Who Is the Greatest of All Flyers?

I SHOULD like to take this opportunity to ask readers of POPULAR SCIENCE MONTHLY who, they think, is the greatest airman the world has ever seen? To start the ball rolling I may say that I would confer that honor on Commodore Kingsford-Smith—perhaps you have heard of him. My reasons for placing him first are because of his four great flights that made him known over the entire world. His first, starting June 1, 1928, took him some 7,000 miles across the Pacific from San Francisco to Sydney, Australia. His second, which he began Sept. 10, 1928, made him the first to fly from Australia to New Zealand, a distance of 1,200 miles. He began his third great flight on June 23, 1930, when he flew across the Atlantic from Ireland to New York, 2,190 miles. On his fourth flight, which started October 9, 1930, he flew from England to Australia, 11,000 miles in eight days. As he also flew across America on July 2, 1930, he has the distinction of having flown around the world.

Well, these are the reasons for my choice —have I stated a sufficient number? I really think that I have, but still, if not, are there any of you American readers who can go me one better in support of some other flyer?—L. E., Victoria, Australia.

High Praise from One Who Really Knows

I WANT to congratulate you on your representation of the motorship *Hydrographer* in POPULAR SCIENCE MONTHLY for July. I certainly envy your artist. I built the ship and can visualize the details because of that long familiarity with the construction, but how could he do so in the short time he was on board? In your "cut-away" representation, it appears as if the real ship were cut away, and one can see the familiar interior in true detail. It is a beautiful piece of work in all respects.—G. T. Rude, Commander, U. S. Coast and Geodetic Survey, Washington, D. C.

Summer Suits of Voile and Rayon for Men!

DOUBTLESS there's absolutely no chance of our dressing this summer as the natives of certain far-off islands are pictured as dressing, but just the same I have a feeling that something should be done about the heavy clothes men wear. Why wouldn't it be a good idea to make men's suits this summer in the ordinary, conventional way, minus a vest, of course, but have them made of material similar to that in women's dresses? Thus we would get lightweight suits full of attractive, or at least startling, colors. —C.P.S., Rochester, N. Y

Our Cover Made Him Think He Was Dreaming

FOR some weeks I have been thinking of a method to make ocean flying safe. On April 29, I was asked to write an essay or a story and I chose to write a story about my idea for safe flying at sea. I have been a reader of POPULAR SCIENCE MONTHLY for five years and when last Monday I picked up the June issue and saw the cover design I thought I was dreaming for there on the cover was my idea. I had not seen any article or picture based on that idea until I saw it staring up at me on the cover of your magazine. I thought I ought to let you know about this unusual incident.—J.M., Brooklyn, N. Y.

Just a Little Knock for Professor Gregory

I HAVE always enjoyed glancing over the interesting mechanical features of your magazine. But I can't swallow such illogical stuff as William K. Gregory presents in the leading article of the June number. On page 19 he dogmatically says, "Scientists now generally consider it probable that life began right here, and that it was produced by chemical forces that had been at work for thousands of centuries." He assumes something about "scientists *generally* believing," when surely he ought to know that they do not consider just what he puts into their mouths. Again, he very likely knows that there is no effect without an adequate cause, and that nothing comes from nothing . . . so he ought to be good enough to tell us just where and how and from what those "chemical forces" got the power to produce life and how they had been at work for thousands of centuries. His statement brings us back to those indefinite chemical forces and then leaves us standing on air. —R.R., San Francisco, Calif.

Good as Detective Thriller But It Is All Wrong

IT HAS never been proven that we got our face from a fish. Amazing ideas and not "amazing facts" would be a better title for your Dr. Gregory articles. Amazing imagination and guesswork on the part of some scientists are necessary to trace our face back to a fish. Believe it or not. But you don't have to as it hasn't been proved and scientists there are a plenty who admit it hasn't. But it is as interesting reading as any detective thriller. And we are to get more of it? What fun!—E.A.Q., South Orange, N. J.

Here's a Bouquet for Hardworking Dr. Gregory

THOSE who are opposed to your articles on "Life—The World's Greatest Mystery" must, if they are to be logical, believe that man is not an animal but is of some higher form of life for which we have no name. But man eats, breathes, sickens, dies like other animals. Surely no sensible person can doubt he is an animal. Then he must have evolved, developed, as have the other so-called lower animals. Why, then, this fear of evolution? For my part I can truly say that I find the Dr. Gregory articles among the most interesting, instructive, and convincing papers that have ever been written on this subject.—J.A.G., Evansville, Ill.

Says Earth Does Revolve 366 Times a Year

PLEASE let me play in that 365-366 day game. Amateurs may be misled by D. G. of Texas in the June issue. Let the rim of your dinner plate represent the earth's orbit. Anything in the center of the plate is the sun. Stick a fork into the North Pole of a potato. Some object at the far side of the table is a distant star to act as referee. Mark a point on the side of the potato (earth) and regard this point as an earth-bound observer. Hold the fork firmly and move the earth through one counter-clockwise round of the orbit, noting the position of the observer with respect to the sun. He says one long day and night elapsed, but that the sun came up in the west and set in the east. Move the earth one complete round (counter-clockwise) on the orbit, keeping the observer always toward the sun. In order to accomplish this you will need to turn the fork (and earth) one complete left-hand revolution in your fingers. The observer says he did not sense any revolution at all. Move the earth around the orbit again and you will have turned the fork in your fingers two left-hand revolutions. The observer says he sensed one long day and night, the sun rising in the east. Astronomers for more than three centuries have known that the number of real or sidereal days in a year is one greater than the number of solar days. —R.D.C., Salem, Ore.

Letter of a Japanese Schoolboy Congratulates

WE HAVE the honor to present to you the message from the Tokyo Mokei-Hihoki Kenkyukai (Tokyo Model Aircraft Society), in trust of Mr. S. Mamiya, who is the chief engineer of Japan Register Co. We are very much glad and thankful to know the trace of the wonderful progress of the mechanical science in your country. Our society was established in Nov., 1930. Our society has five branch offices in and near Tokyo, and about 300 members, all pure and earnest boys. We have been informed of prosperity of the model aircraft making in your country by many books and pamphlets and envious

of the existence of the excellent material as Balsa Wood. It is necessary the friendship of your country and Japan separated by the Pacific Ocean, is held on by the young of the two countries. We should be very much pleased to hear through your magazine young American model builders would be informed of aspiration of young Japanese friends to shake hands with them. To close this message, we congratulate heartily POPULAR SCIENCE MONTHLY's development and well-being of the U. S.—M.K., City of Tokyo, Japan.

Russia and America Seen from Australia

HAVING read Michel Mok's articles about Russia, I thought that your readers might be interested in a comparison in prices of a necessity supplied to Australia by both the United States and Russia.

The necessity in question is petrol for your automobiles. Grade A American petrol is sold from the pumps at approximately fifty-two cents a gallon. First grade Russian petrol is sold at thirty-three cents a gallon. A difference of approximately nineteen cents. At present Russian petrol does not reach us in large quantity, but with improved distribution made possible under American supervision, Australia will buy large quantities of this cheaper petrol to the injury of the American market.—K. S., Sydney, Australia.

His Frozen Fish Either Lived—or Died

SOME time ago I was amused by the controversy in one of your issues regarding the use of a shovel. Being right-handed myself and having known thousands of farmers, miners, and street and track workers, there is no question about a right-handed person placing the right hand next to the shovel where the greatest effort is exerted and throwing to the right. Another amusing article I found in your magazine had to do with freezing fish, thawing them out and then finding them either dead or alive. My first experiment along this line was made when a boy. I placed bullhead minnows in a small tin bucket and left it to freeze. When thawed out these fish were dead. Many years later at Modale, Iowa, a lake bed was drained and when the shallow water froze, the fish came to an air hole to breathe and were easily thrown out onto the ice with a pitchfork. Left to freeze, every one of them came to life when thawed out. —W.R.S., Chicago, Ill.

Drivers Run Drivers That Run Engine

NOTICING your picture pages in a recent number of POPULAR SCIENCE MONTHLY, under the caption "Big and Little Kings of the Rail" I was reminded of a strange engine your readers probably would be interested in. The engine I refer to I saw about fifty years ago on the Erie Railroad track at Buffalo, N. Y. It was designed by Octave Chanute, airplane designer and builder, and was operated with two sets of drivers, one above the other. The upper set, with power from piston, drove the lower set by friction; and the lower wheels, thus powered by the upper ones, moved the engine on the rails.—G.H.E.W., Buffalo, N. Y.

Better and Better—but Is That Possible?

I BELIEVE POPULAR SCIENCE MONTHLY is getting better and better. It is branching out more into the field of general science. I noticed in "Our Readers Say" that one subscriber objected to your articles on Russia. I do not think that the objection was well founded. I thought the articles very conservative and instructive. I do not say this because I lean toward Russian communism, but because I like to learn the facts from whatever source and about whatever subject. I never did take off my hat and run away from the truth, because the truth will make you free. It is ignorance that forges chains and enslaves and keeps us in that condition. —E. F. McS., Rives, Tenn.

Help! Here's Another Age for That Man and Wife

AFTER much figuring I find that H. M. is all wrong on the man and wife age problem. The correct answer is: Wife now 33 3/9 years old; man, 44 4/9 years old. When she is his present age he will be 55 5/9. When he was her age she was 22 2/9. Is not this right?—F.H.S., Bangor, Me.

All He Needs Is a Firm Foothold in Space

WHEN I read W. F. G.'s idea about tall buildings stopping the earth, I thought it best to advise him to have a law passed against high mountains while he is at it. I have heard that New York skyscrapers are some pumpkins, but I still think the mountains out here are higher and heavier. B. McC.'s question also started me thinking. Suppose you could get a firm foothold somewhere off in space and lifted the firmly moored needle with a magnet, could you measure the weight of the earth? Such nut-house questions as this should be abolished, I suppose, but you ought to know me when I'm going good. Also about your Russian articles: If everything is as represented, I am convinced that as soon as the Russians become civilized their present form of government will collapse.—W.M.H.B., Bellingham, Wash.

Here's the Real Low-Down On What a Hobby Means

YOUR editorial, "The Joy of Hobby Riding," in the August issue, made pleasant and interesting reading, but apparently you do not know your modern psychology as expounded by Drs. Freud, Jung, Adler, *et al.* Hobbies, my dear Mr. Editor, are a form of escape from reality, "the unacknowledged transference of the repressed impulses to new aims and objects." Do you keep pets? Aha, your maternal (or paternal) instincts were frustrated! Do you collect old bottles? It either means that you were not given enough bottles when a baby, or that Prohibition thwarted your mature desires for bottled liquids. Do you build ship models? You were kept from following your natural bent for the sea. Do you collect stamps? That, says Dr. Adler, is a symptom of the repressed will-to-power. King George, you may object, is one of the world's foremost philatelists, but the psychologists tell you this is a proof rather than a refutation of their theory. You see, poor King George is a constitutional monarch with hardly any power, and he takes out his frustrated desire for lording it over the earth on his stamp albums. There, he has all the other kings licked! I used to collect old sardine-box keys. When I became acquainted with the theories of the modern psychologists, I was horrified at the thought that this peculiar passion might denote a repressed desire for housebreaking and threw my collection, patiently gathered through the years, into the ash can. Of course, it did not make much difference; as you know, they never work anyway.—F.L.K., Pittsburgh, Pa.

This Little Girl Gives Us a Big Hand

LAST November you very kindly forwarded me a list of the issues of POPULAR SCIENCE MONTHLY from which I could secure information on the subject, "What Chemistry Can Do to Utilize Waste Material in Forestry and Agriculture." I now take great pleasure in telling you that my essay on that subject was awarded first prize in a contest conducted by the American Chemical Society, and I do not hesitate to say that much of this success I attribute to the information I secured from your magazine. It certainly is a worth while publication and one that no home should be without. I feel deeply indebted to POPULAR SCIENCE MONTHLY.—Miss M.H.C., Clark's Summit, Pa.

Would You Like to Know All About Big Pipe Organs?

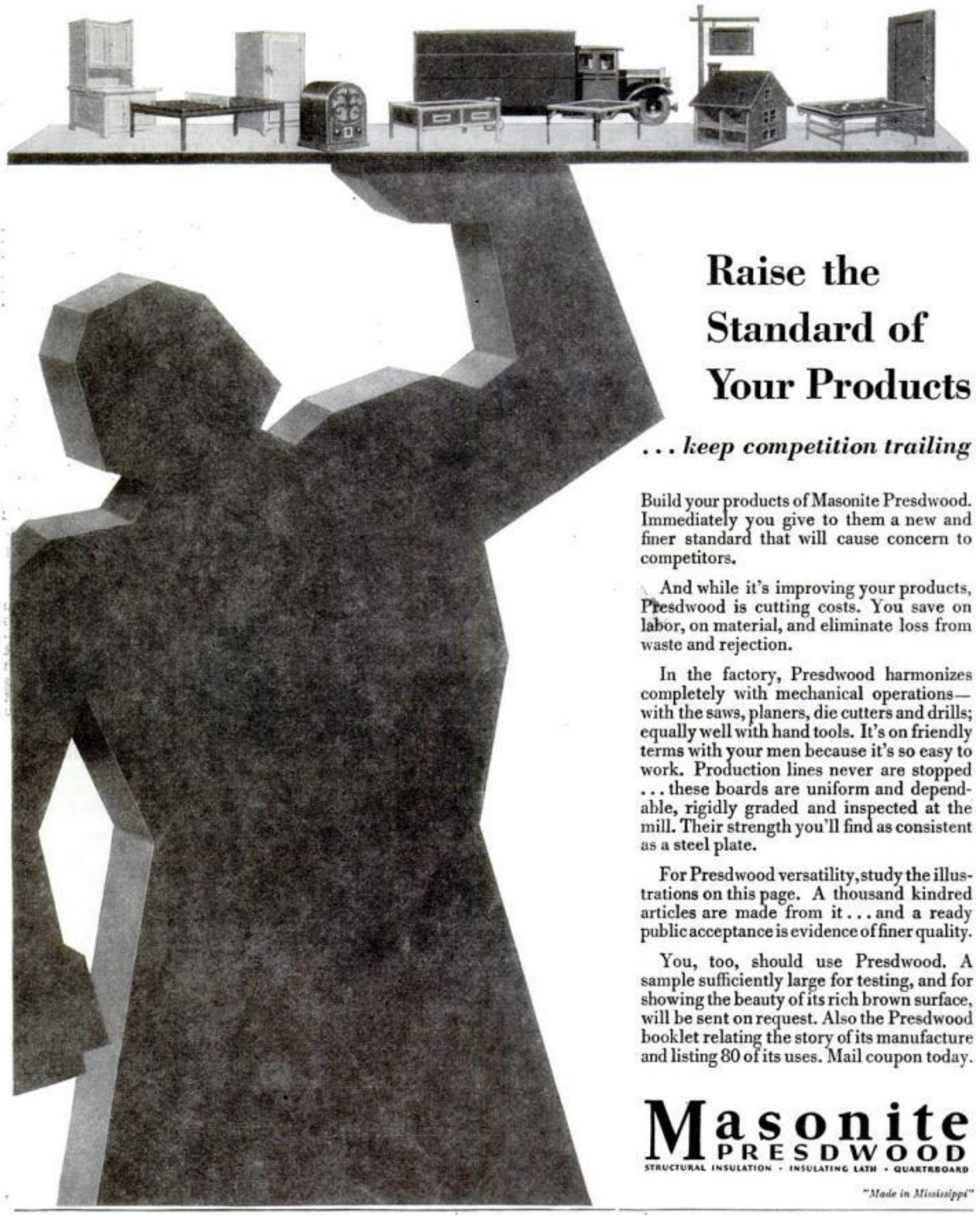
SOME time ago I remember seeing an article in your magazine about the pipe organ. This instrument, as you know, receives more scientific attention than any other instrument made. I believe that you should publish an article fully covering this subject and in this article there should be pictures of the big organs. Please don't think me 'bossy'. I hope to see this article soon, although its omission will not lessen my respect for your magazine. —B.E., Denver, Colo.

His Advice Is to Ignore Those Who Do the Knocking

I THINK your magazine is the best available and want you to disregard the fogies who dislike aviation, shop, or what have you. I would, however, like to join with some others whose items have appeared in "Our Readers Say" in asking for some simple chemistry problems and educational articles along that line. I think that the average reader of your magazine is scientifically minded enough to appreciate such a type of article.—O.P., Jr., Port Huron, Mich.

Just What Do You Mean by "Chemistry?"

I SUGGEST that you comply with quite a few of your readers' wishes and print more *science*. The articles on model building are interesting, but hardly belong in a magazine named POPULAR SCIENCE. Personally, I would prefer chemistry. In a recent letter in which the writer requested chemistry, you headed it "Don't you know chemistry when you see it?" That's just it, we do know chemistry when we see it, but we have not seen it in your magazine. I realize that you can't satisfy everyone, but it seems that you could make your magazine touch all popular sciences more successfully. If chemistry is not a popular science, why do so many American college students major in it?—T.S.B., Fayette, Mo.



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POPULAR SCIENCE
MONTHLY

September 1931 Vol. 119, No. 3

RAYMOND J. BROWN, *Editor*

By JESSE F. GELDERS

Drawing by B. G. Selelstad

Over 2,000 years ago the hocus-pocus about the stars began with the trappings shown above. It is still carried on and many people believe in it.

Famous Scientists TELL WHY Astrology *is a* FAKE

RADIO has given new impetus to the oldest brand of pseudoscientific hokum known to man—astrology. Over a large part of the United States, from two to twenty times a week, the air carries the pompous parlance of charlatans whose like, more than two hundred years ago, were denounced by Swift, the great English satirist, as "ignorant, sottish pretenders."

A modern scientific development designed for public enlightenment, radio broadcasting is used to make thousands of new converts for a form of hocus-pocus dating from times when people believed that the liver was the seat of the soul; that the earth was flat and the sun traveled around it; and that the fortunes of mankind depended on the moods of fickle, half-human gods frolicking on a mountain.

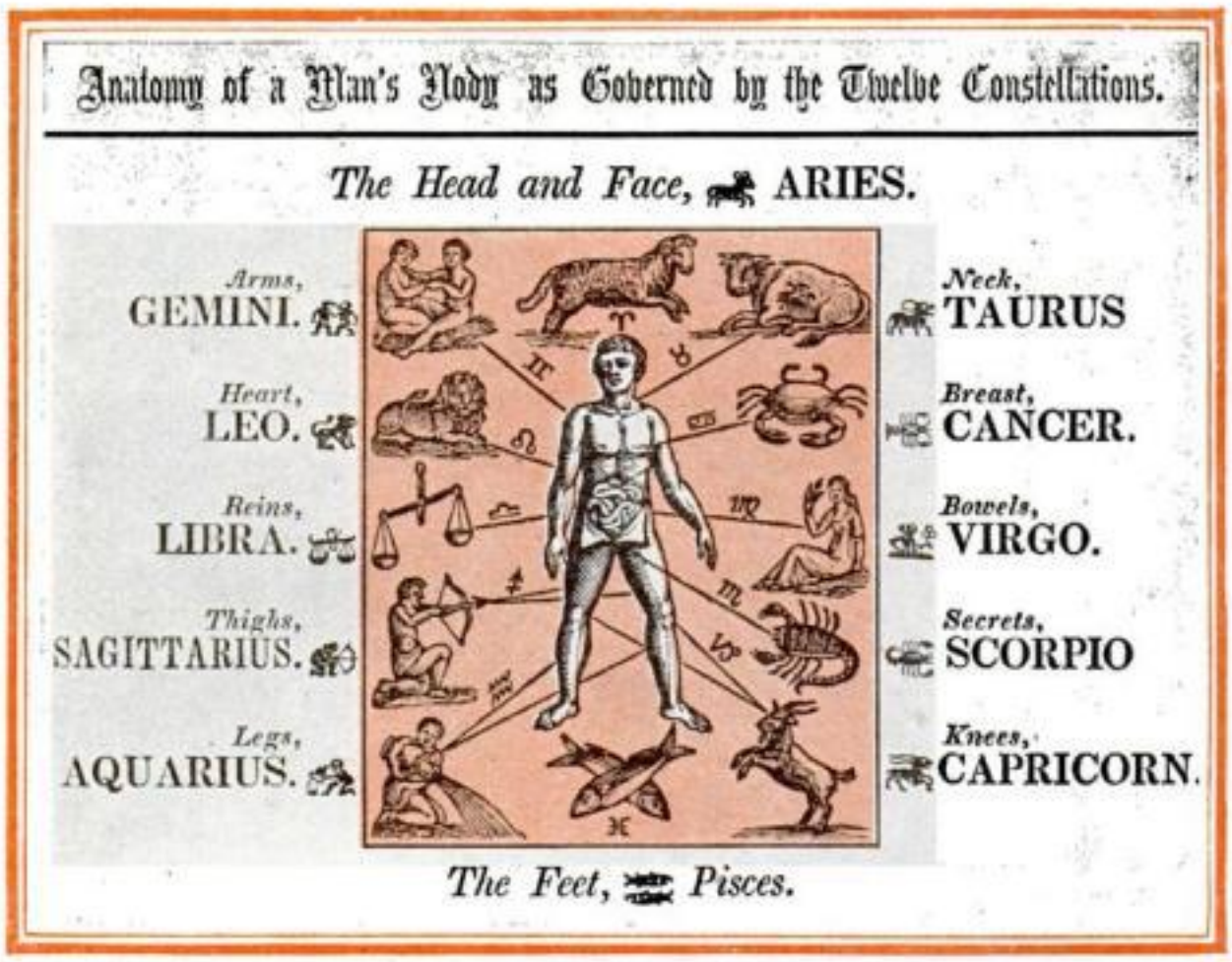
Astrology is the ancient pretense of predicting the future by the relative positions of the earth, sun, moon, planets, and stars. From the positions of these bodies at the time of a child's birth, the astrologer undertakes to foretell its character and probable destiny.

This the businesslike astrologer of today can do no more than could his picturesque predecessor, the sorcerer in cone-shaped hat and star-strewn cloak who flourished in the Dark Ages. Still, the racket, fed on popular superstition and tolerated by official laxity, is permitted to grow and victimize an increasing number of uninformed persons.

The Federal Trade Commission, which has been active in prosecuting sponsors of fraudulent printed advertising, and the Federal Radio Commission, which is empowered to control the radio for the "convenience, interest and necessity of the public," have not prevented the astrologers from "entertaining" their listeners—and getting their money—by telling them when and whom to marry, when and how to play the stock market, and whether or not to have their appendix out.

The radio "lectures" usually serve as bait for the more profitable part of the game, the mail-order end of the business, and those who consult the fakers by letter are, like the rest of humanity, mainly interested in three things—love, money, and health, in the order named.

THESE victims are not confined to the ranks of hopeful spinsters, giggling adolescents, and people in their dotage. They are recruited from all kinds and classes of citizens. Even so-called hard-headed business men, apparently ignorant of matters outside their own sphere, seek the charlatans' counsel on problems of trade and finance, and poli-



This zodiacal figure is designed to show the human organs affected by constellations.

ticians ask them what way the wind will blow at election time. A much more dangerous aspect of the situation is that the sick, who naturally clutch at any straw of hope, often take their advice on questions that should be decided only by competent physicians.

Despite the fact that much of this quackery is practised through the mails, which carry the bulk of the radio astrologers' bogus predictions, the postal authorities have not stopped the impostors from fleecing the public.

It is just as impossible to foretell the future by gazing at the stars as it is by peering at a mess of tea leaves or shuffling a deck of cards. Yet, though the official attitude toward these humbler forms of soothsaying is pretty strict in some places, the astrologers are allowed to wax rich at the expense of the credulous. The reason probably is that their oft-repeated claims that they work on "scientific principles" are believed by many of those who make and enforce our laws.

Is there any truth in these claims? Is astrology really based on scientific principles? Do the planets and stars exert any influence on the welfare, happiness, and character of human beings?

TO obtain authoritative answers to these questions for the readers of POPULAR SCIENCE MONTHLY, I called upon a group of recognized scientists whose life work is to study the stars and penetrate the mysteries of the universe—outstanding astronomers and physicists at some of our great universities, and the presidents of two astronomical societies.

The group included Professor Frank Schlesinger, of the department of astronomy at Yale University; Daniel W. Hering, professor emeritus of physics at New York University; Professor E. W. Brown, of the department of astronomy at Yale, and president of the American Astronomical Society; Dr. Clyde Fisher, curator of astronomy of the American Museum of Natural History, and president of the Amateur Astronomers' Association; Dr. D. Brouwer, of the department of astronomy at Yale; Professor Henry Norris Russell and Professor John Stewart, of the department of astronomy at Princeton; Professor George P. Pegram, of the department of physics at Columbia, and W. J. Eckert, instructor in astronomy at Columbia.

THESE men of science are unanimous in declaring that there is no scientific basis whatever for the deductions and predictions made by the astrologers, and that there are no known forces or influences such as the astrologers ascribe to the stars and planets.

Then why is it that astrologers' predictions sometimes come true? The answer to that question is that such successful forecasts simply are guesses based on an ordinary knowledge of human nature and affairs and the law of averages. In other words, they are guesses that any reasonably shrewd and experienced person, without the slightest knowledge of the heavenly bodies, could make with an equal chance of hitting the mark.

To prove this contention, I conducted an experiment with astrological horoscopes among sixty-three members of the psychology classes in New York University. The test showed that the astrologers' chance of guessing right was about 50-50, regardless of whether the horoscopes were cast to "fit" the particular person or not. The reason for the comparatively high average of "hits" is that the horoscopes are worded in such a careful "give-and-take" fashion as to fit about half of all people who read them.

Dr. Walter Franklin Prince, Research officer of the Boston Society of Psychic Research, recently induced a friend to send the year, day, and minute of birth to six different astrologers, inclosing a fee for a horoscope. The six replies were all different and all wrong. Because he asked each, "Shall I marry this year?" not one learned from the stars that the man was already married. In all social, matrimonial, and business matters the racketeer star gazers guessed ninety percent wrong.

Can't Censor Radio

COMPLAINTS concerning the astrology racket lodged with the Federal Radio Commission invariably have been met with the reply that the Commission lacks the power to censor radio programs. But there are other means of chasing these frauds off the air. Many cities have local ordinances that enable police to stop the graft. The other day, an astrologer, broadcasting from a Cincinnati, Ohio, station, was silenced by a judge of that city. Detectives stationed court stenographers at a receiving set and, the evidence obtained, arrested the faker on a charge of practicing astrology without a city license. He was fined $100 and sentenced to thirty days in the lock-up. What was done in Cincinnati can be done in other cities.

Professor Schlesinger, of Yale, voiced the opinion of the scientists when he expressed himself to the effect that astrology, as most astrologers know, is "the bunk."

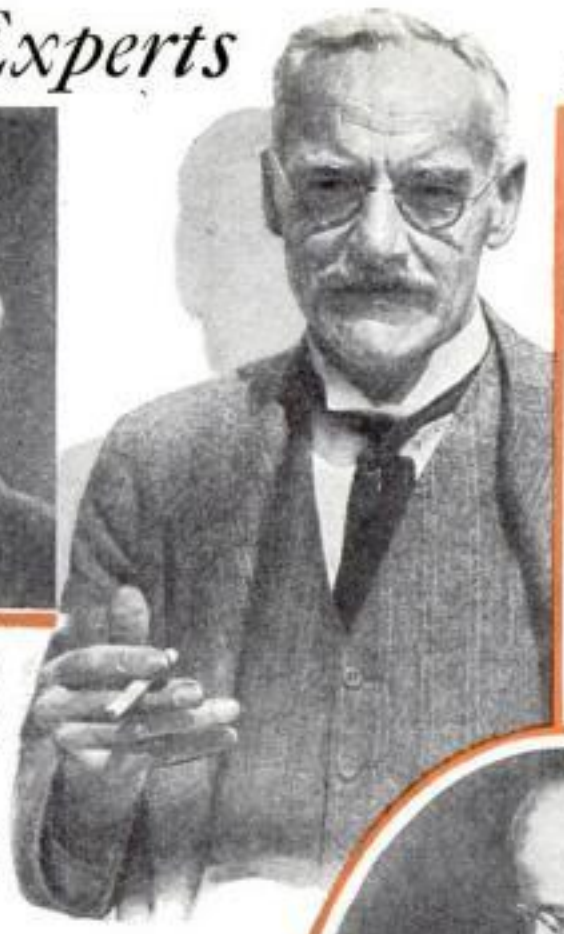
"If there were any basis for astrology, astronomers would be very glad to know of it," he told me. "Some of us have gone into it. I have, and I have come to the conclusion that there is no basis for its claims. I believe that most astrologers are conscious charlatans. A few of them are sincere.

"MOST of them ask the client only what day he was born. Now, thousands of people are born every day. Yet, they have different characteristics, and lead very different lives.

"A few astrologers want to know the exact minute of birth. Of course, very few people are able to give them that information. It so happened that I did know the exact minute of my son's birth.

Star Experts Denounce Astrologers

Dean George B. Pegram of the School of Mines, Engineering and Chemistry, Columbia University.



Right, Dr. E. W. Brown, President of American Astronomical Society.

Dr. Henry N. Russell, Professor of Astronomy at Princeton University.

Left, Dr. Clyde Fisher, astronomy curator, Museum of Natural History.

Daniel W. Hering, professor emeritus of physics at New York University.

I decided to test the 'knowledge' of one of these 'precise' astrologers, and sent him the information. The horoscope I received in return was no more accurate than if a cat had cast it."

Professor Emeritus Hering, of New York University, also has made a personal investigation of astrology. Two words sufficed him to characterize it. He found it "inconsistent and absurd."

AN OPEN-MINDED examination of the radio astrologers' activities by any intelligent person will prove the truth of Professor Schlesinger's and Professor Hering's statements. Their own methods and utterances brand the astrologers as "conscious charlatans" whose conclusions and predictions are "inconsistent and absurd." This is how many of them work their game:

Horoscopes are sent in return for the wrappers of advertised products. Replies are given to questions; and "destiny charts" and tabulations of "favorable and unfavorable hours" are sold for sums of one to ten dollars. Wonder books are offered for sale that are promised to give "accurate answers and conclusions to all of your problems" and "help to physicians in their diagnoses"!

It cannot be denied that the radio astrologers do furnish entertainment of a sort—provided the listener has a sense of humor and keeps a firm grip on his pocket book. Tune in with me on some of the curious pronouncements of these prophets:

"'I have been in love with a young man, born May 4th, for four years,'" one astrologer, in his broadcast, reads from a letter sent in by a client. "'My birthday is March 8th.'"

The astrologer clears his throat and says, "His birth sign indicates lack of interest and fickleness." That finishes the chap who was born on the 4th of May.

Next, he reads a note appealing for help in a matter of business. "'We want to sell our house. Is a favorable sale indicated?'" the letter asks. The astrologer has been in conference with the planets, and knows the answer. "In the June or July transit," he predicts.

"Sally of the Bronx," another client, who writes her birthday is August 21, though the year remains a secret, is told that churchbells will chime and orange blossoms will bloom for her in the last quarter of 1933. Who minds waiting a couple of years for a sure thing?

Another astrologer announces that he has "traveled all over the world for ten years, to solve the mystery of luck." Apparently, he did not succeed in solving it for himself, for instead of having retired, he is still working the radio racket. But he has solved it for others. Success in business, love, horse-racing, and everything else, he declares, is simply a matter of starting things at the right time. Incidentally, one dollar will bring you his astrological "time-table" with the favorable starting hours for any pursuit, over a three-months' period.

IF YOU go in for astrology in a serious way, your horoscope represents only the "original cost." The "upkeep" includes the price of monthly reports. One astrologer explains that he puts them out only one month ahead "in order to insure last-minute accuracy." In view of the fact that the movements of the heavenly bodies can be calculated hundreds of years in advance, this explanation is one of the most entertaining bits of chatter I have heard from the radio prophets.

So far, their vaporings were amusing enough, and fairly harmless, but listen to this statement from a sooth-sayer of the air who as yet has not been silenced by the proper authorities:

"Astrology is an *exact science*. We can tell with precision exactly what you can expect."

THIS is a gross and dangerous falsehood. Astrology is *not* an exact science. It is not a science at all. And an astrologer can no more foretell the future than can you or I. The stars and the planets "have nothing to do with the case." Here are the facts, as they were told to me, in substance, by the distinguished astronomers and physicists to whom I talked on the subject:

The bodies of the solar system provide the motion for the heavenly apparatus which the astrologers consult in their hocus-pocus. The stars, which are distant suns, really move also, but they are so far away that their positions with respect to one another do not seem to change over long periods of years. They almost appear to be fixed on a great dome-like ceiling, the sky. As the earth moves in its orbit around the sun, the sun seems to trace a circle around the sky, completing it once a year.

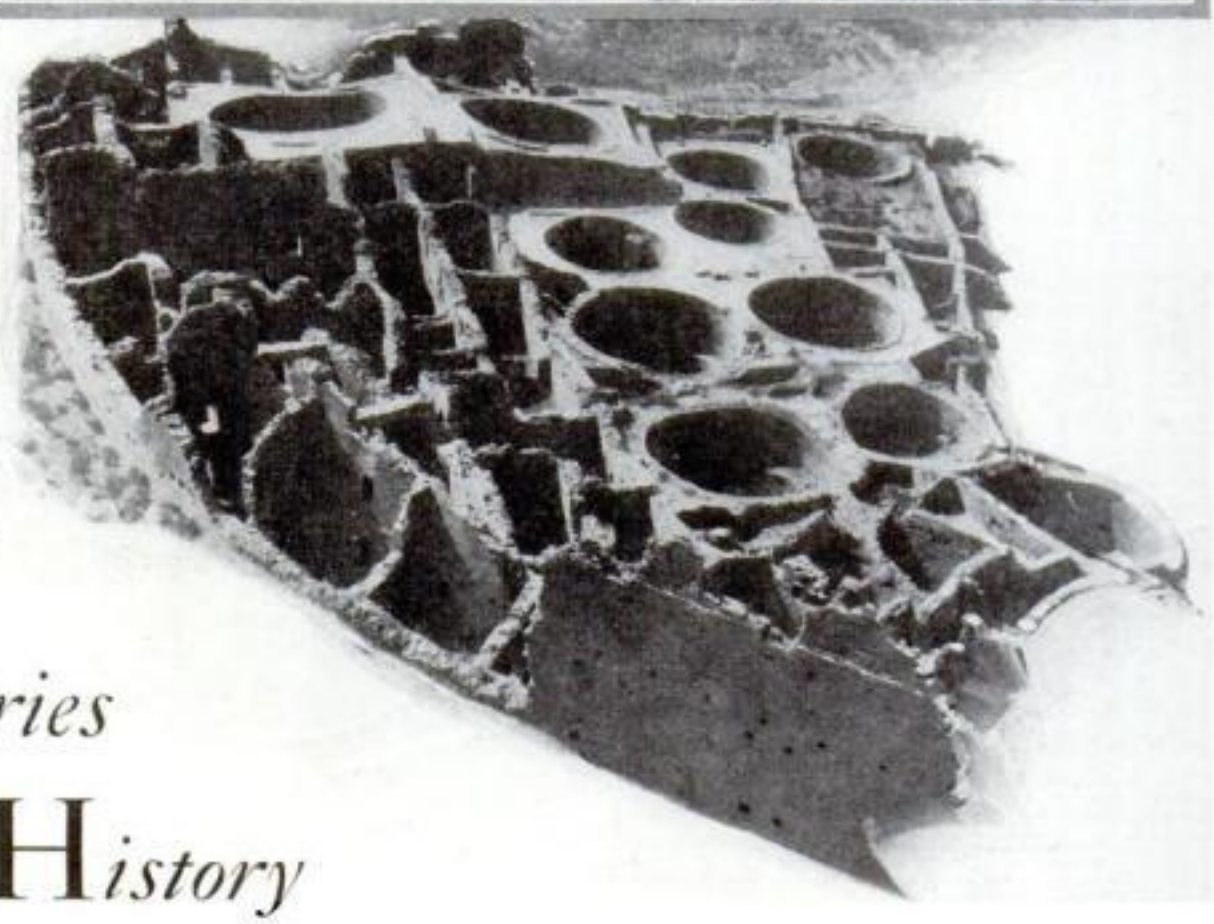
This circle is known as the ecliptic. The groups of stars through which this sun-path seems to pass are the constellations of the zodiac. Not only the sun, but all of the planets as well, have their apparent courses in this belt of the heavens.

These phenomena were observed from the earliest recorded times. But the priests of ancient Babylonia, about 3000 B. C., probably were the first to work them out into an orderly system. This was the origin of astrology, and the forerunner of modern astronomy.

As a matter of fact, astrology and astronomy were the same thing for many centuries, though a distinction was made between "natural astrology," which concerned itself with predicting eclipses and the other *(Continued on page 112)*

By
ANDREW R.
BOONE

At right, sawing out beams at Sichomovi from a hut erected in A.D. 1400. Below, beam ends that were originally shaped with stone axes that badly smashed the wood. At lower right, view of Pueblo Bonito ruins in Chico Canyon, N. M., whose excavation led to attempt to date Southwestern ruins.



Twelve Centuries of American History Revealed *by* Ancient Trees

PUSHING the horizons of American history back to seven centuries before the coming of Columbus, solving puzzles of ancient Indian ruins in the Southwest, revealing tense dramas in the lives of prehistoric men, and adding invaluable information to our knowledge of weather and its mysterious cycles, a 1,200-year tree-ring calendar has been pieced together by Dr. Andrew E. Douglass, of the University of Arizona at Tucson.

So important is his work that he has just been awarded the $2,500 Research Corporation Prize by the Smithsonian Institution, Washington, D. C.

One of the most dramatic results of his thirty-year study of tree rings was discovering the exact age of Pueblo Bonito, the mysterious metropolis of the ancient Southwest. Found in the Chico Canyon of New Mexico, this oldest known Pueblo ruin had been an archeological enigma for generations. Its prehistoric inhabitants had no written language and they left no calendars.

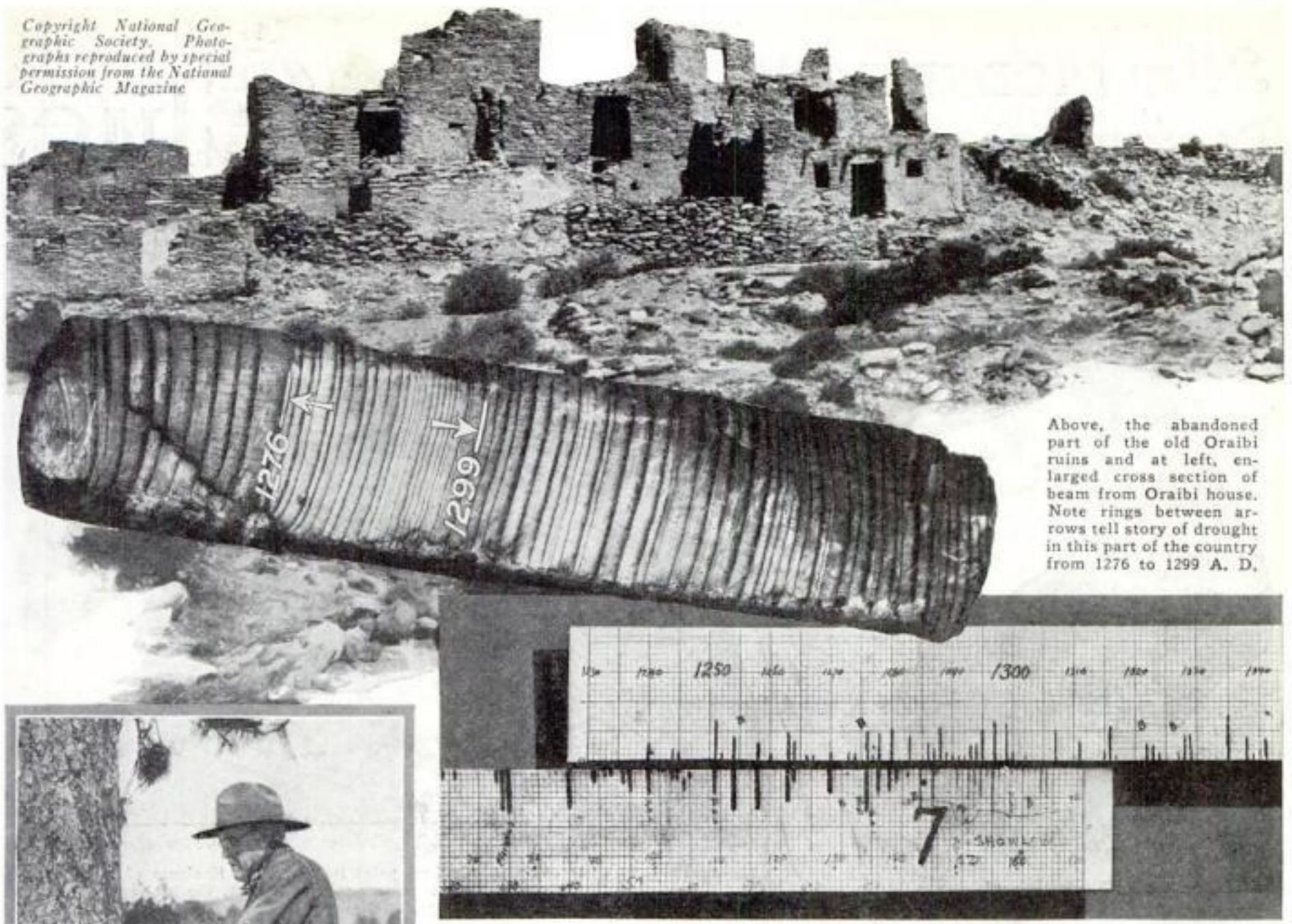
Dr. Douglass, however, has read their secrets in wood and charcoal that once were beams in the ancient dwellings. He found the city was under construction in A.D. 919 and reached its heyday in 1067.

Similarly, by making microscopic examinations of ancient timbers in other ruins and by boring cores from beams still in use, he has dated sixty other communities in which early tribes once made their homes. Among these are the canyon palaces of the ancient Arizona cliff dwellers, one of which, its timbers reveal, was being built in 1066, the year William the Conqueror invaded the British Isles.

Thirty miles north of Navajo Springs, Ariz., Dr. Douglass made special study of the ancient ruins of Kinnah-Zinne. According to the legends of the Southwest, the early Spaniards took refuge here when attacked by the Indians. One log came to light that dated from 1728 to 1804, thus proving the ruins had been standing at the time the white adventurers marched through the country.

At another ruin, a small boy in the party spied a three-inch lintel, used to decorate the outside of a doorway, sticking out of the ground. It was the only remaining piece of wood, the rest having been burned a century before. Under the microscope, the rings of this tiny piece of prehistoric juniper told their story, proving the crumbling dwellings had been built in A.D. 1192.

IT WAS an investigation of sun spots that led Dr. Douglass, an astronomer, to his unique study of old woods, in 1901. As everyone knows, each ring in the cross section of a log represents a year of growth. In addition, the width of the ring varies according to the amount of rainfall. Thus the astronomer was able to note the effect of eleven-year sun spot cycles on rain and drought by examining



Above, the abandoned part of the old Oraibi ruins and at left, enlarged cross section of beam from Oraibi house. Note rings between arrows tell story of drought in this part of the country from 1276 to 1299 A. D.

The two scales above were made from two separate studies of tree rings, the heavy black lines indicating the years of drought. When the scales were put together it was found that these lines coincided exactly, thus proving the accuracy of the calendar in wood worked out by Douglass.

A. E. Douglass boring a core section from a living pine for study in his tree laboratory.

rings of century-old pines and Douglas firs.

Continuing his researches, he studied beams that had been shaped by stone axes centuries before the coming of the white man, and charred timbers dug from the oldest ruins. In the end, by overlapping specimens and matching rings, he pieced together a remarkable wooden calendar that reaches back to A.D. 700.

Besides allowing the accurate dating of any ruin containing timbers, this tree-written record forms a precise 1,200-year calendar of rains and droughts.

In it, Dr. Douglass found recorded the dramatic story of a great catastrophe, unknown to history, which afflicted the inhabitants of the Southwest about the time of the last Crusade. In the year 1275, the tree-ring records show, there was abundant rainfall—the last for twenty years. Before the dawn of American written history, this terrible drought, during which no rain fell on the high plateaus, left its mark upon every living thing.

The Indians changed their mode of life, and for a time the populous Pueblo cities were abandoned.

In translating these diaries kept by ancient trees, Dr. Douglass has found ample evidence of long-time weather cycles in which conditions reoccur. Like the regular beating of waves, he discovered, changes take place over hundred-year and three-hundred-year periods. He also proved definitely that a thousand years ago, rain in the Southwest was far more plentiful than at present.

HIS twelve-century graph gives science the first opportunity to study precise weather records extending far beyond the days of the first weather bureau. These records, made by natural rain gages and studied in the "Tree Ring Laboratory" in Tucson, promise to play a pioneer part in making long-range weather forecasting an actuality.

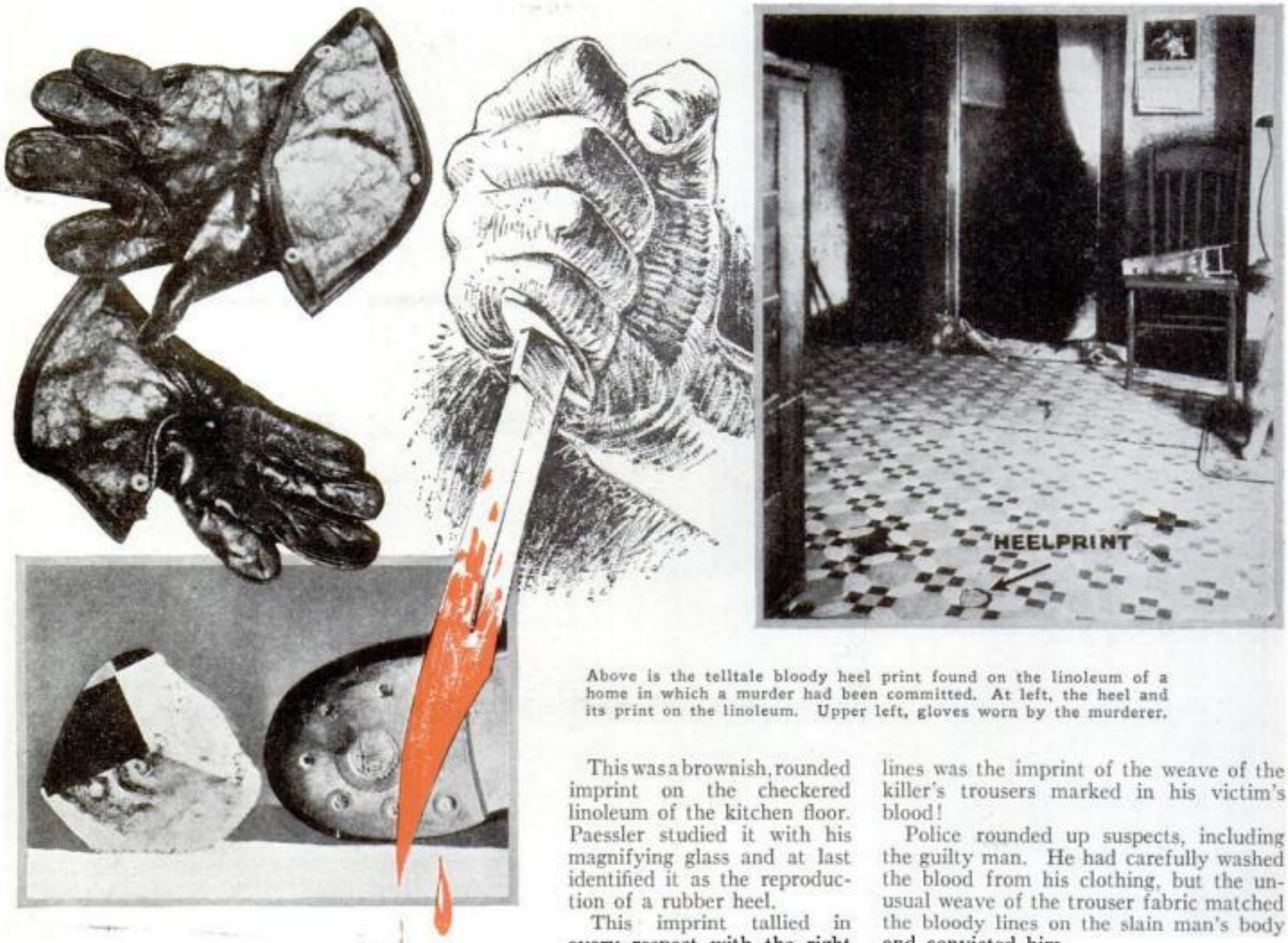
All told, Dr. Douglass has examined more than half a million rings in his fireproof basement workshop at Tucson. When he completes the study of a new specimen, he plots the high points of rain and drought on a piece of paper. Then he can easily determine the exact age of the wood by moving its graph, in the manner of a slide rule, along the master chart that covers the whole 1,200 years, until drought lines match. Never, he reports, has he found two logs that "fingerprinted" exactly alike unless they were produced at the same period.

IN HIS wood-hunting trips, Dr. Douglass has covered most of the Southwestern plateau country where ruins are found. He has traveled through Arizona, New Mexico, southern Colorado, and southern Utah. In the field, when precious pieces of prehistoric charcoal are dug up, they are carefully dipped in a solution of kerosene and paraffin to protect them for later study in the laboratory.

Besides the thousands of specimens of fir and pine which are piled in tiers along the wall of his laboratory, Dr. Douglass is now adding cross sections of stumps from the famous redwood trees of northern California. By studying them, he hopes to push the horizon of accurate weather history back three thousand years.

As the Rosetta Stone solved the mysterious writings of ancient Egypt, Dr. Douglass' tree ring diary not only has opened a new path to the study of weather but has reconstructed the pageant of primitive nations that rose, reached their zenith, and disappeared in the lost past of America's history.

How MODERN SLEUTHS *read* Murder Clues



Above is the telltale bloody heel print found on the linoleum of a home in which a murder had been committed. At left, the heel and its print on the linoleum. Upper left, gloves worn by the murderer.

STUMBLING through swirling snow along an outlying street, a Wilkes-Barre, Pa., policeman tripped over the body of an elderly man crumpled face downward in bloodstained drifts. Papers in an inner pocket identified the victim. The patrolman flashed word to headquarters. Robert Paessler, chemist and scientific detective, took up the trail of the unknown slayer.

He quickly unearthed the following facts: On the night of his death, the murdered man had been staying alone. His daughter, a mute, and her husband, who made their home with him, were visiting relatives in a neighboring town. During the evening, however, the son-in-law had left this place and had not returned until two o'clock in the morning. He declared he had attended a movie. Witnesses substantiated his story. Suspicion pointed to him, but he had a perfect alibi.

Carrying a special 1,000-watt, nitrogen-filled lamp—twenty times more powerful than the electric lights you use in your home—Paessler searched the home of the murdered man. One stain, faint and overlooked, stood out in the white glare of the lamp's probing beam.

This was a brownish, rounded imprint on the checkered linoleum of the kitchen floor. Paessler studied it with his magnifying glass and at last identified it as the reproduction of a rubber heel.

This imprint tallied in every respect with the right heel of the shoe worn by the suspected son-in-law. Yet, as the latter protested, what more natural than that his muddy heel print should be found in the kitchen of his own home? From about the nails of the heel, Paessler scraped dark matter and tested it chemically. It was not mud, but dried human blood, as was also the brownish material that made up the heelprint on the floor. This single heel mark was an eloquent witness. It placed the murderer at the scene of the crime, upset his alibi, and resulted in conviction.

ANOTHER sensational case in which the blood of a murdered victim wrote the death warrant of the slayer occurred not long ago in France. Boys, playing on a lonely stretch of vacant lots, found a body, stabbed in a score of places. In the clotted blood near a wound on the shoulder was an odd series of wavy, parallel lines.

Studying these marks with his pocket microscope, the detective in charge of the case was deeply mystified, but at last a possible explanation flashed into his mind. The murderer evidently had leaped on his victim as he fell, and, kneeling on his shoulder had plunged his stiletto again and again into his body. The parallel lines was the imprint of the weave of the killer's trousers marked in his victim's blood!

Police rounded up suspects, including the guilty man. He had carefully washed the blood from his clothing, but the unusual weave of the trouser fabric matched the bloody lines on the slain man's body and convicted him.

IN THESE two cases, the blood-inscribed clues were clearly legible. Many times, however, the scientific detective works with single drops and tiny stains, with dried particles in dirt, with faint blood traces discovered in garments that have been washed again and again.

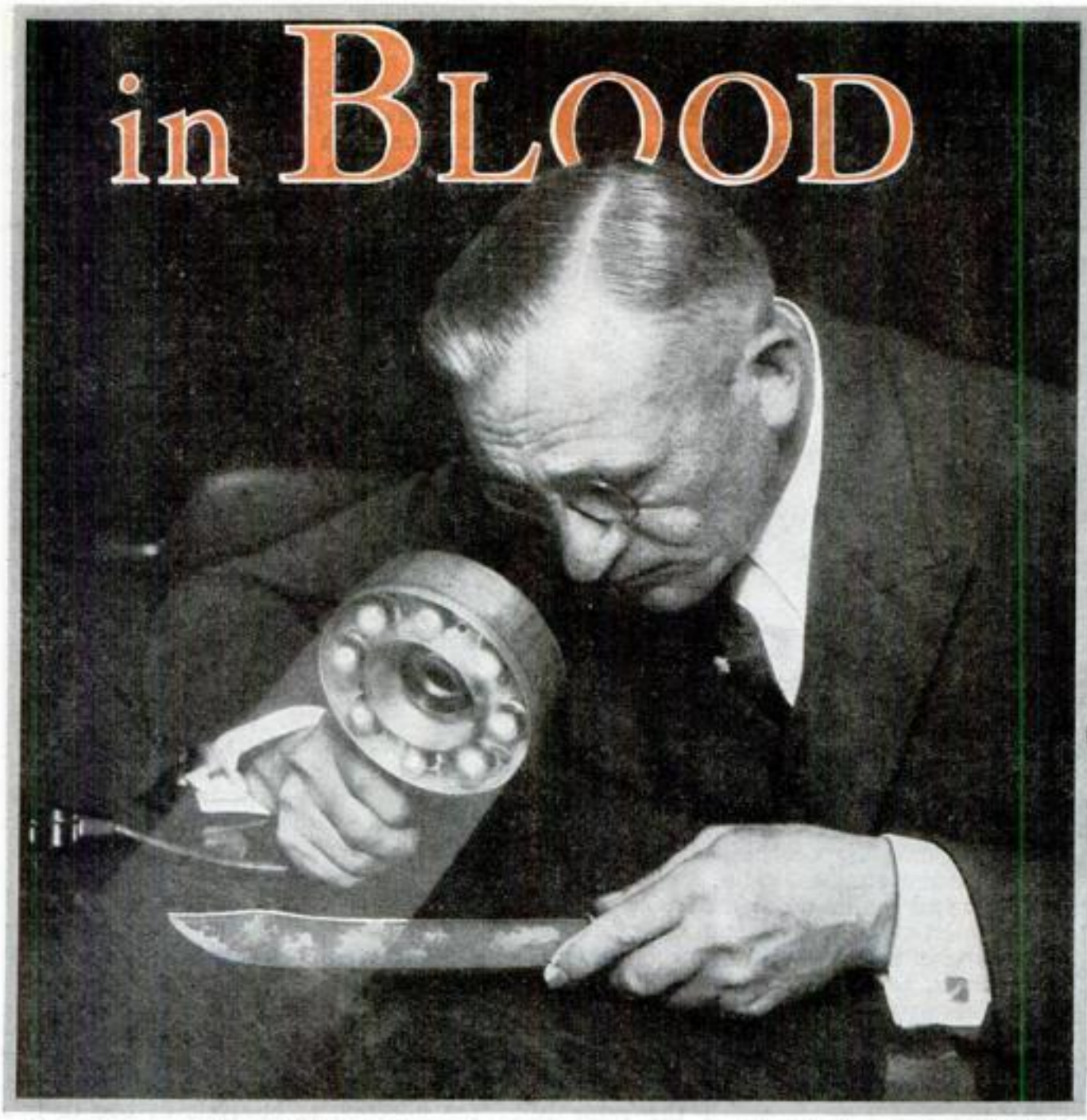
During recent weeks, I have had an opportunity to watch such men in action. At the Scientific Crime Detection Laboratory, in Chicago, I saw them trailing elusive criminals through tiny stains. I learned the amazing methods they have developed and I handled the instruments they use. From the lips of those who have played important parts in thrilling true-life dramas of crime detection, I heard the details of their captures. Fighters on the crime front from coast to coast gave me first-hand stories of murderers caught by telltale stains. Men just home from abroad related the astonishing feats of great European investigators.

In their amazing work, these modern man-hunters, I learned, are employing the latest discoveries and apparatus of the laboratory. They search for stains with special electric-lighted magnifying glasses; utilize testing reagents of a dozen kinds; carry on researches in the mysterious

in BLOOD

More Thrilling Than Any Fiction Written by Master Novelists Is This True Record of Swift Solutions of Mysterious Crimes

By EDWIN W. TEALE



With this powerful electrically lighted magnifying glass, experts can study lethal weapons and disclose fingerprints or blood stains which may be photographed, enlarged, and used in solving the mystery.

This picture shows the most likely hiding places for telltale bloodstains, overlooked by slayers.

realm of colloid chemistry. They work with rare, colorless serums, reacting strangely to the microscopic red disks that contain the hemoglobin, or red coloring matter, of the blood.

WITH super-power microscopes, they study infinitesimal crystals within red corpuscles only three thousandths of an inch in diameter. With blood-testing spectroscopes—recent adaptations of those magical instruments that tell us what distant suns are made of—they note the gases a life stream carries. With these valuable allies from the laboratory, the 1931 detective trails the modern murderer.

Not long ago, a brilliant piece of such work resulted in the capture of a murderer in Chicago. Tenants of an apartment house smelled gas escaping from a room on the third floor and summoned police who broke down the door and found a mother and her six-months-old child dead. Apparently the mother had deliberately turned on the gas. Then a scientific detective, peering into the eyepiece of his blood-testing spectroscope, dramatically announced that, instead of a suicide, it was a carefully-planned and fiendish murder.

The instrument into which he looked breaks up the light that enters it into the rainbow hues of the spectrum. When the rays pass through a normal blood solution before entering the spectroscope, the observer sees two brownish bands appear near the merging line of green and yellow. But if carbon-monoxide, the lethal vapor that makes both illuminating gas and auto fumes deadly, is present, the bands shift to the right, toward the green.

Tests of the baby's blood showed them shifting; of the mother's standing still. In this manner, the telltale lines revealed that the woman had been smothered, probably with a pillow, after which the murderer released the deadly fumes to cover up his crime. But for the quick research possible with the spectroscope, he would undoubtedly have escaped.

As an aid to discovering blood spots at the scene of a crime, experts are conducting extensive researches to determine color changes that take place under different conditions. Most people think of bloodstains as always red or brown. Heat, moisture, cold, and chemicals affect them so they are found in every imaginable hue. Sometimes dried blood is light olive green, sometimes light rose, again it may be practically colorless, and occasionally it assumes the exact shade of the material upon which it rests.

Such an "invisible" bloodstain figured prominently in a sensational case in Austria a few years ago. The wife of a nobleman disappeared. Police suspected him of murder but had no tangible clue. They called to their assistance Hans Gross, famous detective of Prague. Gross fine-combed the apartment where the slaying was thought to have occurred. Powerful lights and microscopes disclosed nothing to substantiate the suspicion of the police. Baffled but persistent, Gross took down a many-colored tapestry that hung in a doorway and examined it with his fingers, inch by inch. Suddenly he touched a stiff place in the fabric. Chemical tests disclosed this to be blood. It was invisible because the coloring matter of the blood had merged with the dyes of the tapestry, making the stains indistinguishable from its multicolored background. Starting with this clue the detectives were able to establish the murder they suspected and unearth sufficient evidence to convict the dead woman's husband.

WHEN stains appear on polished furniture, often a reddish brown, they are particularly difficult to see. Sometimes it is necessary to photograph such tables and chairs to discover the spots. The camera records differences in the amount of light reflected by the polished wood and the dried blood that are not visible to the human eye. Occasionally, dried blood is almost invisible on dirt-

C. W. Muehlberger, chemist and toxicologist at the Scientific Crime Detection Laboratory, shows how the faintest traces of human blood may be used in tracing a criminal.

Blood of one creature can be told from that of another by the shape and angle of crystals in the red corpuscles. Above are crystals as seen in rabbit's blood and left those in cat's.

Courtesy Carnegie Institution

encrusted steps. I heard of one instance in which a detective examined a ladder found in a cellar from top to bottom without finding any stains. Then a photograph made by magnesium light revealed clearly a dozen spots on a lower step.

Unless a murderer is insane, his first impulse after committing a crime is to wipe the blood from his hands. Frequently he uses his handkerchief, later destroying it. But he invariably forgets the lining of his pockets where the blood-stained cloth was carried. A score of times, scientific detectives have cut small pieces from the pocket-lining of a suspect, found blood traces, and secured a confession.

Outwitting these blood-trailing detectives is a main concern of the average killer. In a western city, a few years ago, a cold-blooded murderer stripped himself naked before committing a crime. When the blood that splashed upon his body had dried, he replaced his clothing and left the scene of the slaying without any telltale stains upon his garments. Captured in another city, he confessed his method of escaping detection.

IN another case related to me by one of the Chicago experts, a homicidal maniac bought an overcoat several sizes too large for him. Although drenched in blood after the murder, this coat protected his other garments. When he had destroyed the overcoat and carefully washed his hands, he thought himself safe. But the minute traces of blood under his fingernails betrayed him.

In examining a suspect for blood marks, the trained scientific detective makes a careful study of all material scraped from under the fingernails, searches in the garment hems for the red coloring matter which collects when stains are washed away, and soaks the shoes and analyzes the water for hemoglobin.

Occasionally, fortune favors the officer of the law and he catches the criminal before bloodstains can be removed. In this manner, not long ago, a San Francisco murder mystery came to a swift and dramatic conclusion. Stealing into a house after midnight, an assassin had slashed the throat of a sleeping man. A detective trailed the suspect, caught him before he could clean his bloodstained razor, and carefully examined the blade. Among the dried specks that coated the steel he discovered a tiny thread—a fiber that exactly matched the material in the collar of the pajamas worn by the victim and through which the razor had slashed!

Often a suspect will declare that suspicious stains were made by paint, coffee, tobacco juice, medicine, or some other dark liquid. The first question the detective must answer is: Is it blood?

The microscope will often reveal the structure of the red corpuscles and give the answer. In difficult cases, chemical reagents, such as benzidine and sodium perborate, are added to solutions containing blood. So accurately do these chemicals react to the presence of blood in a solution that dried particles smaller than a sand grain can be detected. A few years ago, mummy wrappings from the tombs of the Pharaohs were so tested. The sensitive chemicals reacted almost immediately to the ancient stains made by blood that flowed thousands of years ago when all Europe was barbarian territory!

One night, a few months ago, in Rochester, N. Y., the proprietor of a poolroom was shot during a stick-up. The next day, a detective arrested a roustabout with bloodstains on his overcoat. He claimed he had been carrying meat for a wholesale butcher and the stains came from beef blood. Police traced him and found he had recently worked in such a place. They called in a blood expert to examine the coat. He studied the stains, made painstaking tests, and reported positively that the blood had come from the veins of a man—was human blood. As a result the suspect stayed in jail charged with the crime.

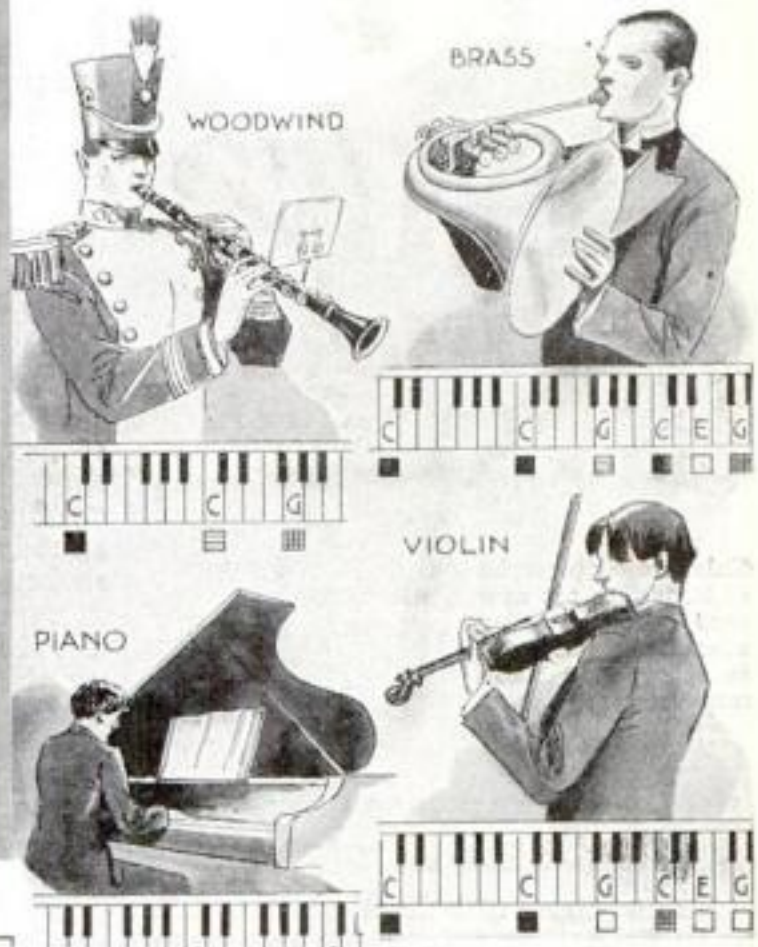
HOW does such an expert tell the kind of blood that made a stain? In accomplishing this important feat, rabbits help him!

First, freshly drawn human blood is allowed to coagulate. The watery, straw-colored serum is then drawn away from the clots. Small quantities of this serum are injected, at intervals of one or two days, into the veins of rabbits. Here it is a foreign substance, an irritant that results in the formation in the animal's blood of antibodies, analogous to the antitoxins produced in the blood of horses by injections of diphtheria virus.

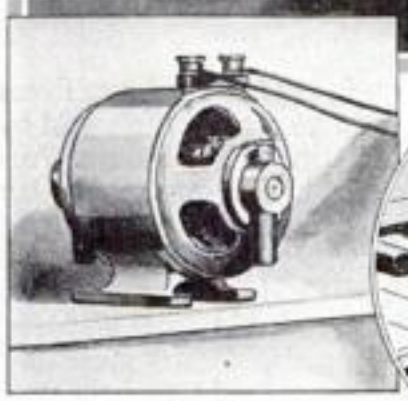
Then the rabbit is killed, the blood allowed to coagulate, and the serum drained away and preserved. It is called "anti-human serum." Biological supply houses carry it in stock. The expert soaks suspicious stains from a garment in a very weak solution of common salt. Placing the mixture in a test tube, he adds a few drops of serum. If the stains are human blood, white precipitate forms a ring within the tube. But if chicken or any other type of blood *(Continued on page 111)*

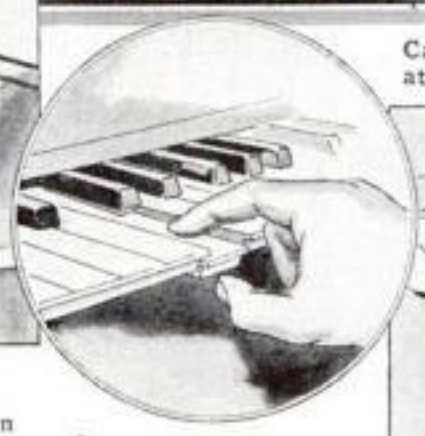
Fingerprints, such as the one above, now can be made transparent and thus matched with other prints by placing one upon the other. This method was devised by Leslie T. White, right, connected with the District Attorney's office of Los Angeles.

RADIO HUM IS MUSIC OF *Amazing* Pipeless Organ

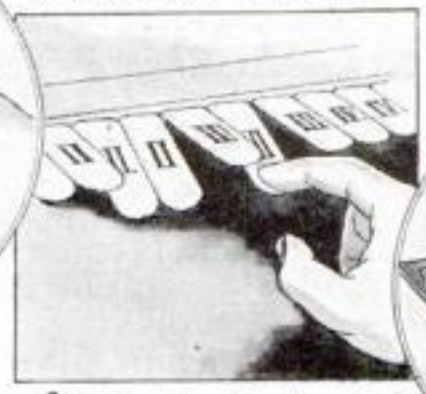


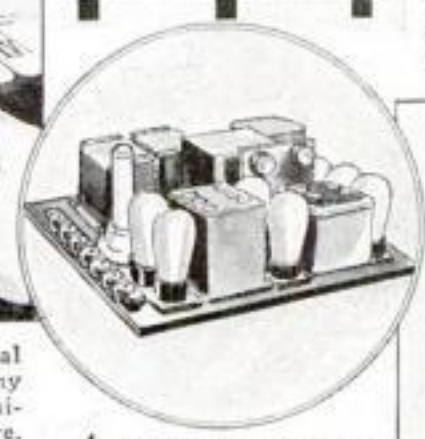
Squares show occurrence and strength of overtones that give an instrument its characteristic sound.





Capt. Richard H. Ranger at new organ he invented.





HOW IT WORKS

1 Running dynamos give an electric hum corresponding to pitch of different tones.

2 Pressing a key closes a six-contact relay and passes along hum of six dynamos corresponding to fundamental tone and five overtones.

3 Tabs blend fundamental tone and overtones in any desired proportion to imitate instrument's timbre.

4 Amplifier magnifies blended tone from a low whisper to a roar.

5 Loudspeakers reproduce notes struck on keyboard to imitate desired instrument.

BY TAMING the electric hum that annoys owners of all-electric radio sets, and putting it to work to produce music, Capt. Richard H. Ranger, radio engineer, Newark, N. J., has created an amazing new musical instrument.

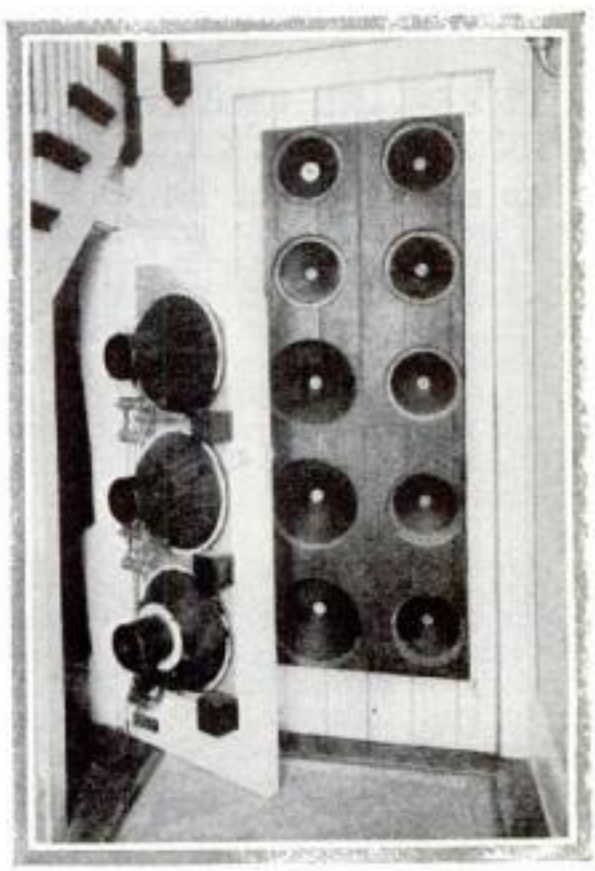
This remarkable pipeless organ produces music electrically from loudspeakers instead of organ pipes. It imitates any instrument. Strains of a violin, piano, or banjo, or, if desired, music unlike that of any instrument yet invented, come from its loudspeakers. The organ commands in all 3,000 different effects—many, of beautiful quality, never heard before. So revolutionary is the instrument that Leopold Stokowski, famed musical conductor, said after hearing it that a few of these organs might replace an entire symphony orchestra in the near future.

The performer sits at an organ console of conventional appearance. He needs no special ability. A pianist can master the new instrument in a few weeks; an organist, instantly.

Since the organ has no pipes, it may be installed in the smallest church, theater, or private dwelling. A home model with simplified keyboard might cost $5,000, according to Captain Ranger. Preliminary plans have already been made to market this new and unusual instrument.

Ranger is known to the scientific world for his important inventions in the wireless transmission of pictures. He is not an expert musician. But when radio experience taught him the shortcomings of ordinary musical instruments for broadcast purposes, he sought an instrument to create pure tones electrically. A dozen tiny alternating current dynamos gave him the tones of the musical scale by producing hums in loudspeakers, just as alternating house current creates a hum in an all-electric radio set unless filtered out. By fitting each key of an organ keyboard with an electric contact to turn on a hum of the desired pitch, Ranger achieved a crude organ of flutelike tones.

THEN he went farther. Each instrument, such as violin or piano, owes its characteristic tone, or timbre, to overtones that sound in addition to the actual note struck. Ranger added electric controls to his instrument to mix in these overtones. A row of stops enables the organ to imitate any instrument, while master buttons, an additional refinement, duplicate a few of the commoner instruments for rapid changes during a recital.

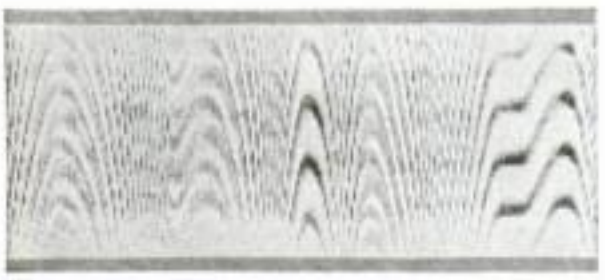


Instead of organ pipes, these loudspeakers, taking up but little space, produce the music.

Enlarged photographs of butterflies are now used in Los Angeles schools to aid children in recognizing those most frequently seen.

BIG BUTTERFLY PHOTOS NOW USED IN SCHOOL

PHOTOGRAPHS of butterflies enlarged to many times their natural size now teach Los Angeles children to recognize familiar kinds by name. The big pictures were recently introduced in the nature classes of the schools. They give a more vivid impression of the insects' beauty than the average textbook drawing, and are accurate to the minutest detail. The butterfly whose picture is shown in the illustration is a yellow "swallowtail" typical of the southern part of the state of California.



TREE-LIKE GRAIN SEEN IN ELECTRIC CURRENT

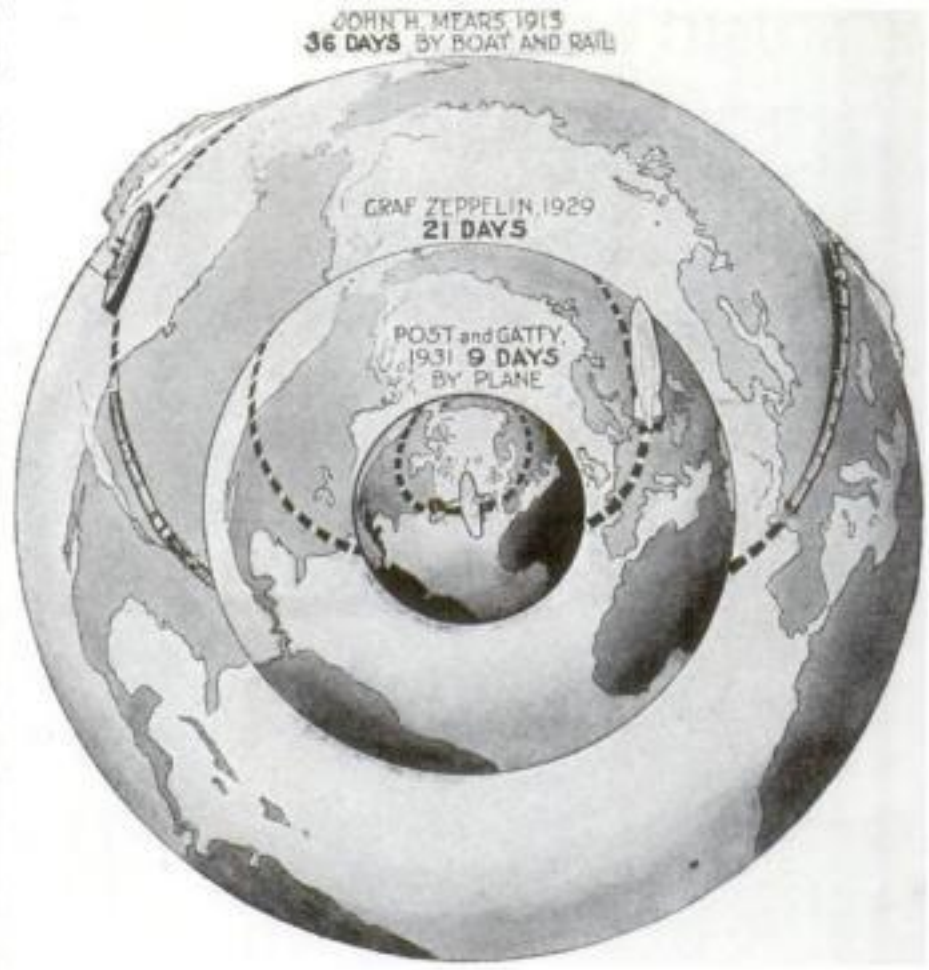
AN ELECTRIC current "sat for its portrait" recently in a New Jersey laboratory and the result strikingly resembles a picture of grains in a hardwood floor. Controlled by frequency, two needles bobbed up and down, striking an inked ribbon above a chart, every time the direction of the alternating current switched. Slight frequency changes in the two generators supplying the current produced the unusual pattern.

MIKE GUARDS THE BABY

ELECTRIC alarms now guard the baby. An official of a Chicago electrical concern recently declared that a dozen parents had rigged up these devices so that they could keep tab on the youngster. One couple connected a microphone over the baby's bed with a loudspeaker in a neighbor's home. When the mother goes to town, the neighbor can listen for baby's cries and render help if necessary.

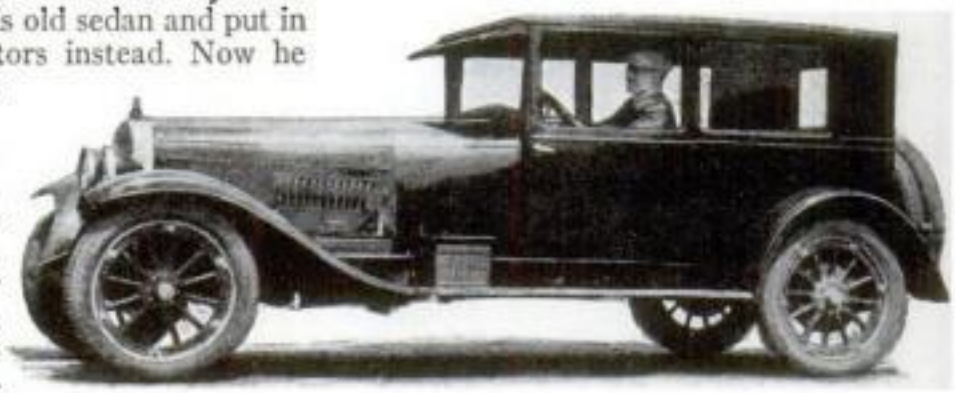
FOUR CENTURIES OF GLOBE CIRCLING

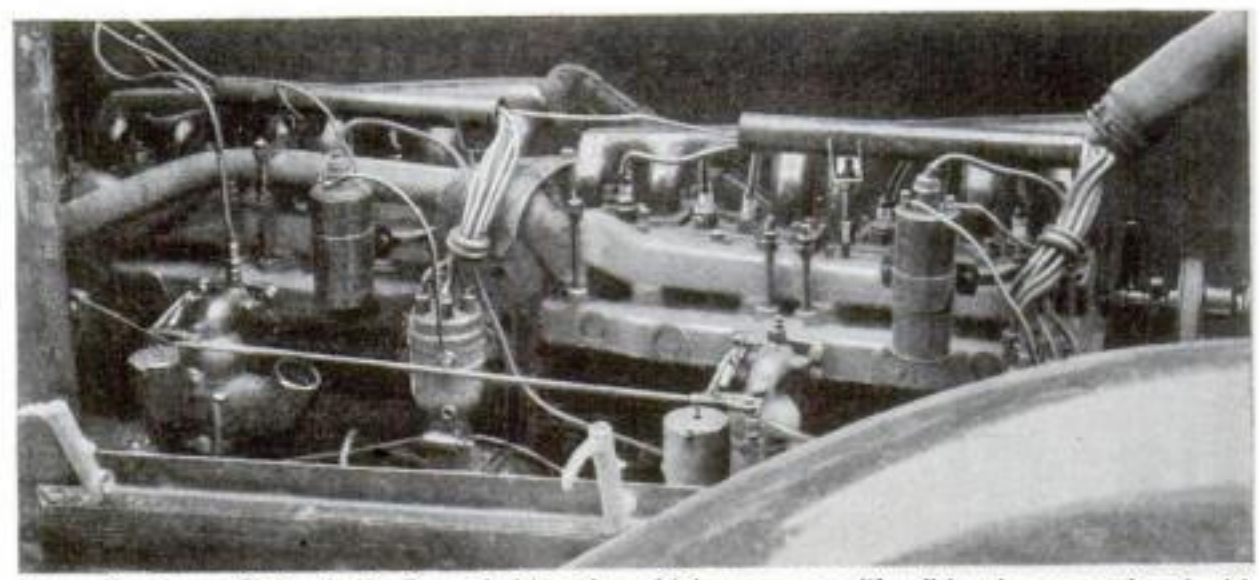
ROUND-THE-WORLD record seekers are shrinking the size of the globe we live on, measured in the time it takes to get from one place to the next. When Wiley Post and Harold Gatty circumnavigated the earth in slightly less than nine days a few weeks ago, they cut in less than half the best time that had previously been made in 412 years of globe circling. The accompanying diagram shows not only the striking way in which speedy travel has slashed distances within recent years, but also the successive triumph of rail and water, airship and airplane travel. The first round-the-world travelers used ships alone. Earliest of them was Fernando Magellan, one of whose ships sailed completely around the world in 1,084 days in the years 1519-22. It was not until 1889 that Jules Verne's famous romance, *Around the World in Eighty Days*, inspired adventurers to attempt to duplicate the feat described in fiction. In that year Nellie Bly traveled around the world by boat and rail in the remarkable time of seventy-two days. New railroads and better ships enabled John Henry Mears to circle the earth in thirty-six days in 1913. U. S. Army flyers became the first to go around the world by air in 1924. The trip took 175 days. Airplanes played a part in the twenty-nine-day record of E. S. Evans and Linton Wells, in 1925, and the twenty-five-day record of J. H. Mears and C. B. Collyer in 1928. Then, in 1929, the airship *Graf Zeppelin* went around the world in slightly more than twenty-one days—a record that held until the recent flight of Post and Gatty.



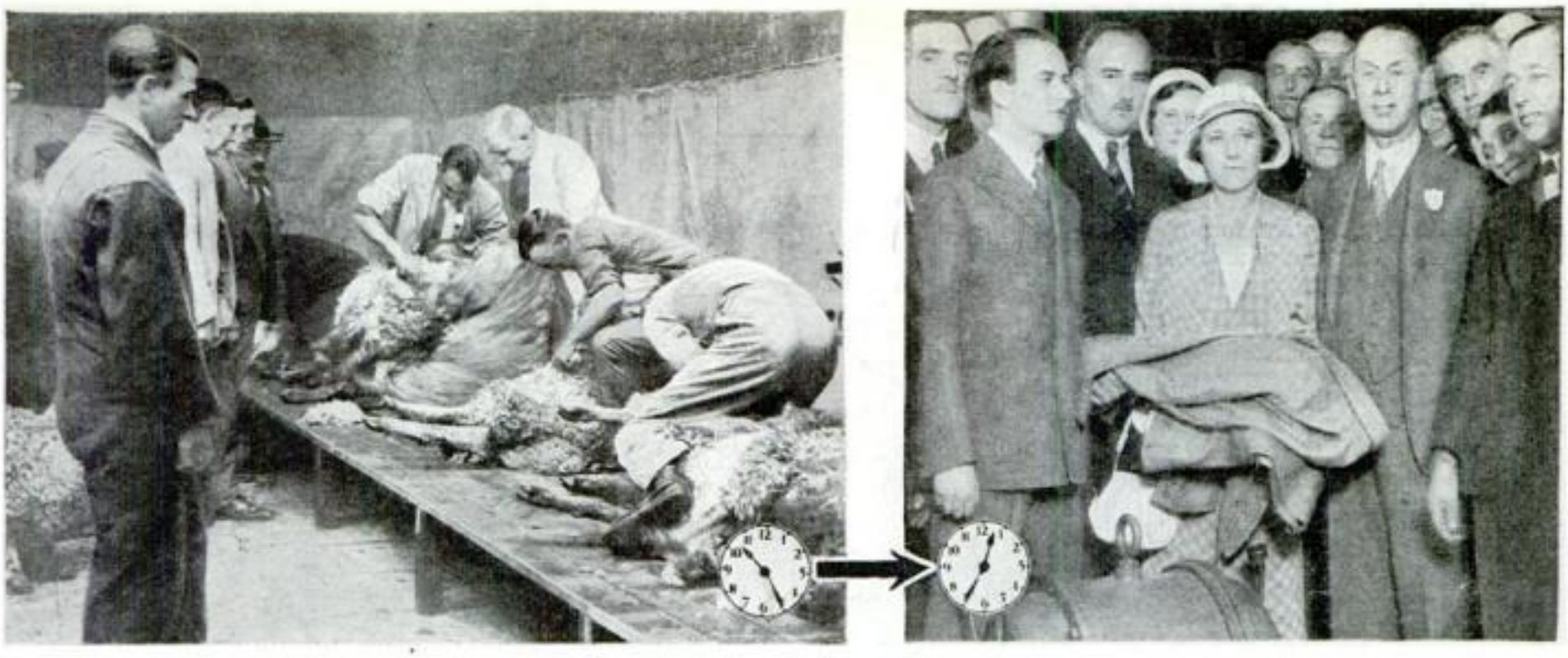
TURNS OLD "FOUR" INTO "TWIN SIX"

ONE motor was not enough for Frank van Slyke, of Anita, Iowa, so he and the town blacksmith took the four-cylinder power plant out of his old sedan and put in two six-cylinder motors instead. Now he says his car flattens the steepest of hills. On level roads he can drive at racing speed. The odd appearance of the car, with its elongated motor compartment, is seen in the upper photograph. Its two motors are mounted in tandem, as shown in the picture at the bottom of the page.





At top, Frank van Slyke, Anita, Iowa, in his sedan which was once a "four" but is now equipped with two "sixes." Above are the two motors now in Van Slyke's car and which are mounted in tandem.

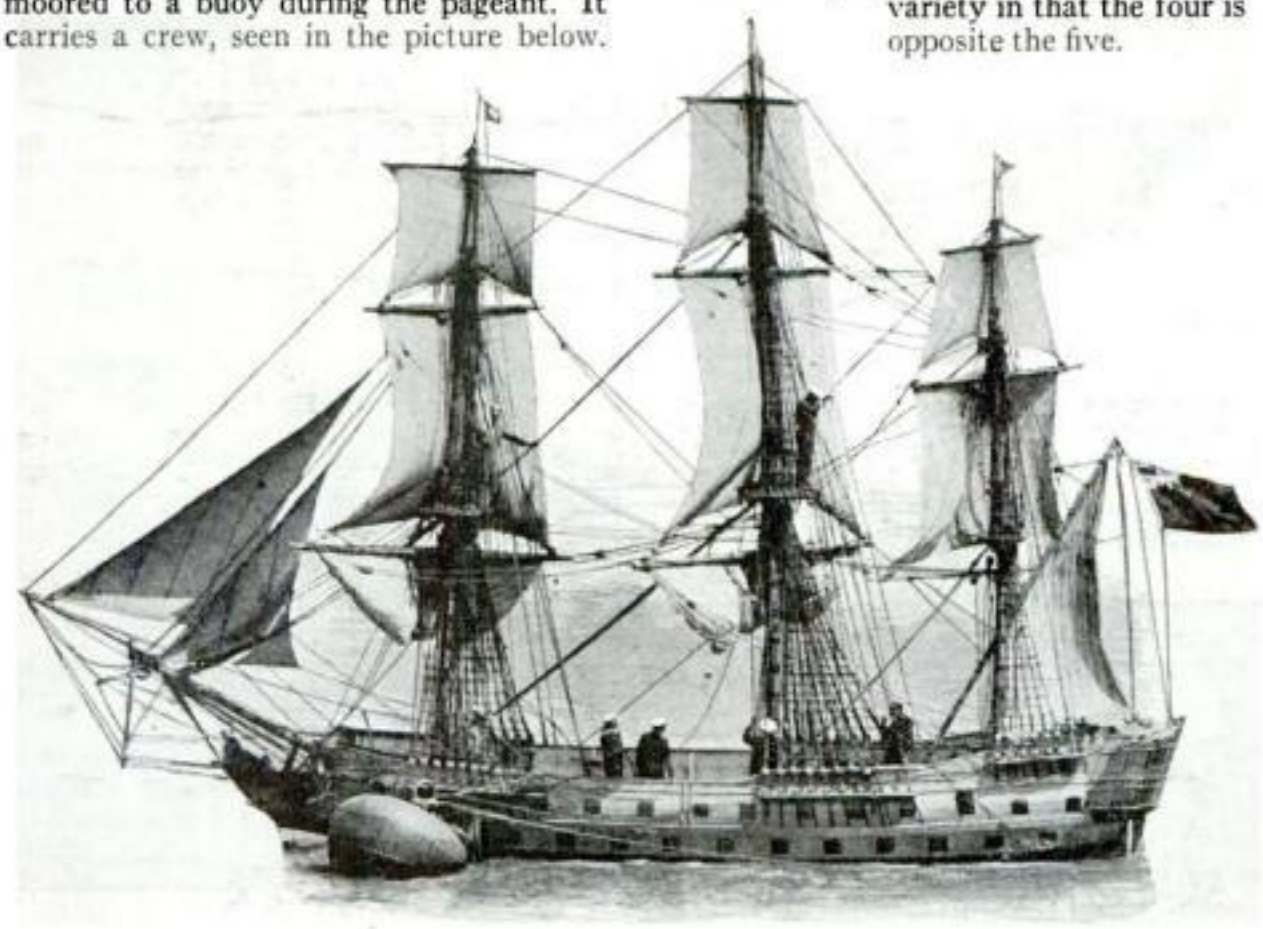


WOOL GOES FROM SHEEP TO SUIT IN 130 MINUTES

SHEEP were shorn, and the wool woven into a man's suit, in 130 minutes in a speed trial held recently at a British clothing factory near Huddersfield. One of the accompanying photographs, showing the lambs being shorn, was taken at 10:25 A.M. and the other shows the completed suit being exhibited at 12:35 P.M. the same day. This is said to be a new record for the stunt.

MODEL OF FAMOUS SHIP SEEN DURING PAGEANT

A HUGE model of a sailing craft, unusual in its dimensions, appeared recently at Rochester, England, to take part in a historical pageant. Named the *Victory*, this novel creation recalled the days when square-riggers with wooden hulls fought the battles of the sea. Its namesake, a 186-foot *Victory* built in 1759, was Lord Nelson's flagship, and her hundred guns helped win the famous Battle of Trafalgar —the naval engagement with French and Spanish warships off Cape Trafalgar, Spain, that was the occasion of Nelson's often-quoted utterance, "England expects that every man will do his duty." This remarkable model of a wooden-hulled sailing ship was photographed as seen below while moored to a buoy during the pageant. It carries a crew, seen in the picture below.



FORTY CENTURIES AGO MEN ROLLED DICE

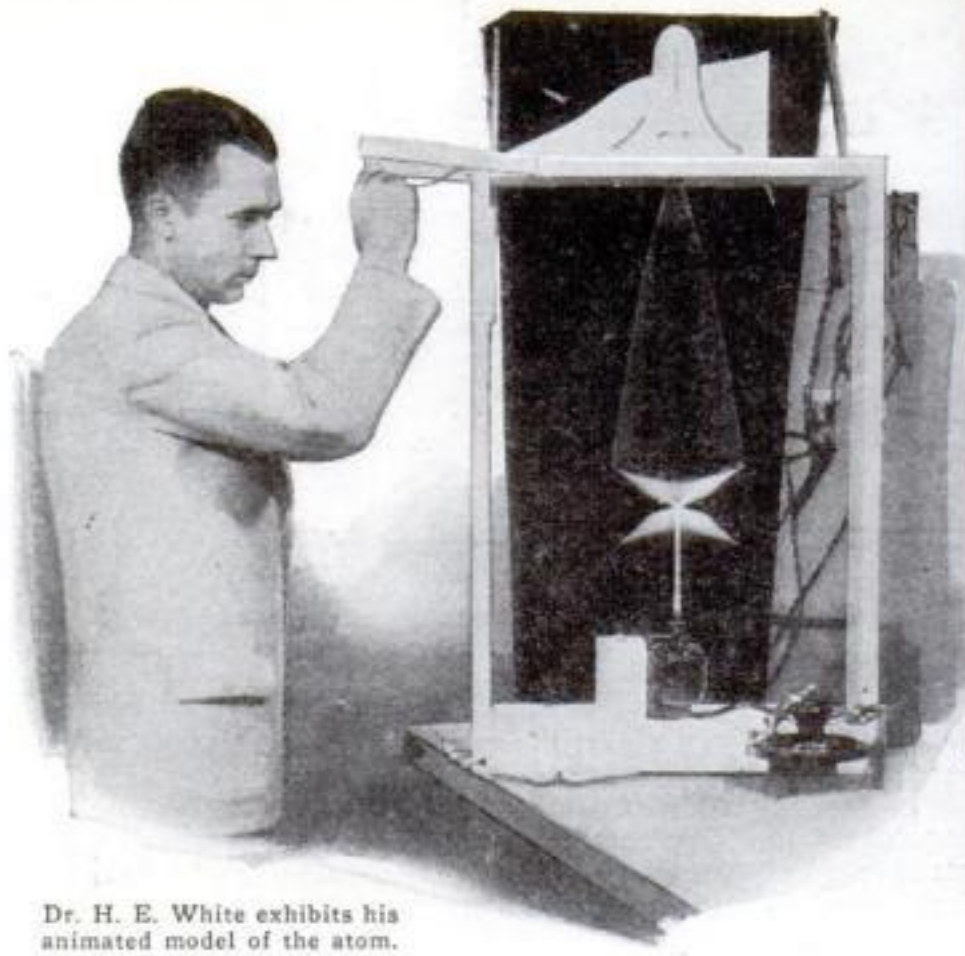
IN THE year 2750 B.C., people rolled dice that closely resemble those in use today. This surprising discovery is announced with the return from Mesopotamia of Dr. E. A. Speiser, who excavated one of the ancient dice. It is made of baked clay and is cubical in shape. It differs from the modern variety in that the four is opposite the five.

WIRED RADIO MAY PRINT NEWSPAPER IN HOMES

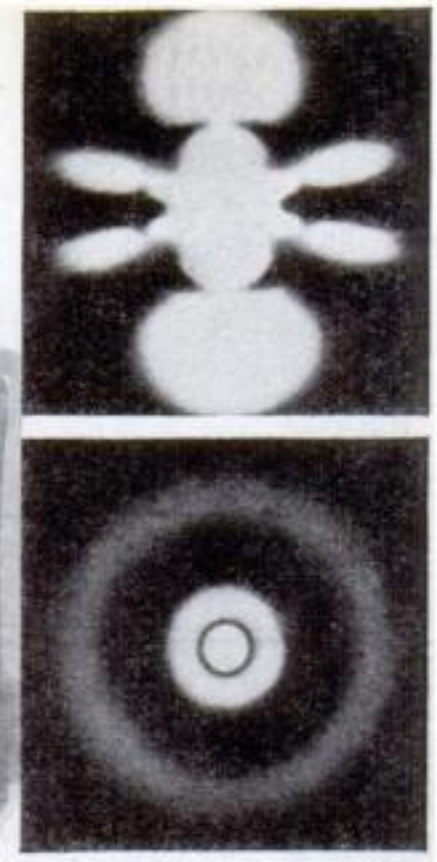
AN ILLUSTRATED newspaper printed by radio in your home will give you up-to-the-second news, if plans of a New York radio firm are realized. Already an experimental home receiver, which prints news broadcasts automatically, has proved successful in tests, officials of the concern have revealed to POPULAR SCIENCE MONTHLY. It resembles an ordinary radio cabinet with a glass-covered top where the end of a roll of paper emerges. News reports would be broadcast from a central station over electric light wires. Illustrations and text are printed upon the moving roll of paper in the top of the instrument.

Animated Model Demonstrates New Idea of Atom

No longer do scientists picture an atom as a sort of miniature solar system, with individual electrons swinging like planets around a sun-like nucleus. Difficult to visualize, outside of a mathematical formula, is the more modern idea of an atom, which has been described as like "a swarm of bees around a hive, when the observer is too far away to see the individual bees." To help make clear this rather complex idea, Dr. H. E. White of the University of California recently constructed an ingenious animated model of the atom in accordance with the new theories of wave mechanics. This model is a motor-driven spindle which can rotate at any angle to the horizontal, and which is connected by a string to a ball that rolls back and forth in a slot. Photographs of the model in motion give the best obtainable picture of atoms as modern scientists imagine them. From time to time atoms are supposed to gain or lose energy, and these changes can also be shown.



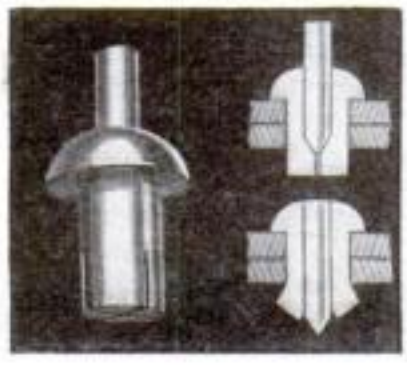
Dr. H. E. White exhibits his animated model of the atom.



At top, the hydrogen atom as pictured in different energy states by the model. The rings in view above represent the "clouds" of electricity that replace electrons in new idea of atom.

FEDERAL EMPLOYEES NOW FINGERPRINTED

All appointees to the Federal Civil Service are now fingerprinted, and the prints are attached to the application papers and retained permanently in the Civil Service files. This procedure marks a departure from the old association of fingerprints with criminals. Fingerprinting was first adopted for identification in British criminal courts in 1891. Since then, however, its uses have spread. Recently they were made part of an application for a motor vehicle license, in some states. A number of banks employ fingerprints to identify their depositors.



At right, the self-clinching rivet and diagram showing how it is spread as firing pin is driven down center.

REMOVABLE HEEL TOPS

New removable "heel tops" for women's shoes may be interchanged between left and right foot to compensate for uneven wear, or replaced entirely by new ones. Each top carries a metal prong that fits snugly into a socket in the special heel of the shoe. The top may be pried out when desired. Shoes are supplied to users with the special heels and extra tops.

Photo shows the removable heel top for women's shoes and hole by means of which it fastens on.

RIVET CLINCHES ITSELF

Self-clinching is a new automatic rivet, which may be applied by a single workman from the outside of the work. When it is placed in the hole, a few taps of a hammer drive a "firing pin" down its center. This spreads the slotted end and forms a head inside the work. The new rivets are made in iron, brass, and duralumin, the last being used in airplane construction. They come in various sizes to suit the work at hand.

TALLEST BUILDING SAVES OTHERS FROM LIGHTNING

How the world's tallest building protects its neighbors from lightning was demonstrated strikingly the other day in the high-voltage laboratory of the General Electric Company, at Pittsfield, Mass. A model of the Empire State Building and the New York area surrounding it was exposed to 5,000,000-volt bolts of artificial lightning. The currents struck the building's tower repeatedly and passed off harmlessly to the ground, just as they would do if they struck the actual building. Engineers estimated the Empire State structure creates a cone-shaped area of protection more than half a mile in radius.

Drawing shows model of Empire State Building struck by 5,000,000 volts of artificial lightning.

GLIDER PILOT CAUGHT IN POWER WIRES

His glider entangled in the power wires of Sea Cliff, N. Y., this youthful pilot dangled near death for half an hour.

ODDEST of glider accidents was the experience of fourteen-year-old Sidney Carlson, of Sea Cliff, N. Y., when he tried to fly a friend's soaring craft. He took off from a hill, rose to a height of about forty feet, and then lost control. The glider dived into a number of telephone and power wires and hung there. Would-be rescuers were endangered by the high-voltage lines until power was shut off. Then firemen reached young Carlson with a ladder and brought him down unhurt though he had dangled close to death for half an hour. The glider was not damaged in any way.

With the lawn mower upside down, the attachment shown below bolts to the handle to form an edger.

TURNS LAWN MOWER INTO AN EDGER

A NEW attachment for any lawn mower equips it to trim the edges of lawns along a path. For this purpose, the mower is turned upside down and drawn along the border. A sharp cutter disk is forced into the turf by the weight of the mower, leaving a clean, sharp line. The attachment, put in place in a few minutes, does not interfere with the use of the lawn mower for ordinary grass cutting. The cutter disk is attached to the handle with two bolts.

EIGHT WHEELS ON ARMORED CAR

A STUDY in wheels is the Army's newest armored car. Six of them are used in ordinary travel, but a fourth pair on the side lifts the car's middle over high bumps that would otherwise strike the frame. These pivoted wheels are interchangeable with the others. The new armored car, with three guns, speeds across level country at fifty-five miles an hour. Three-eighths-inch armor plate shields the body and armored vanes can be closed to protect the car's engine. A four-wheel drive gives firm traction.

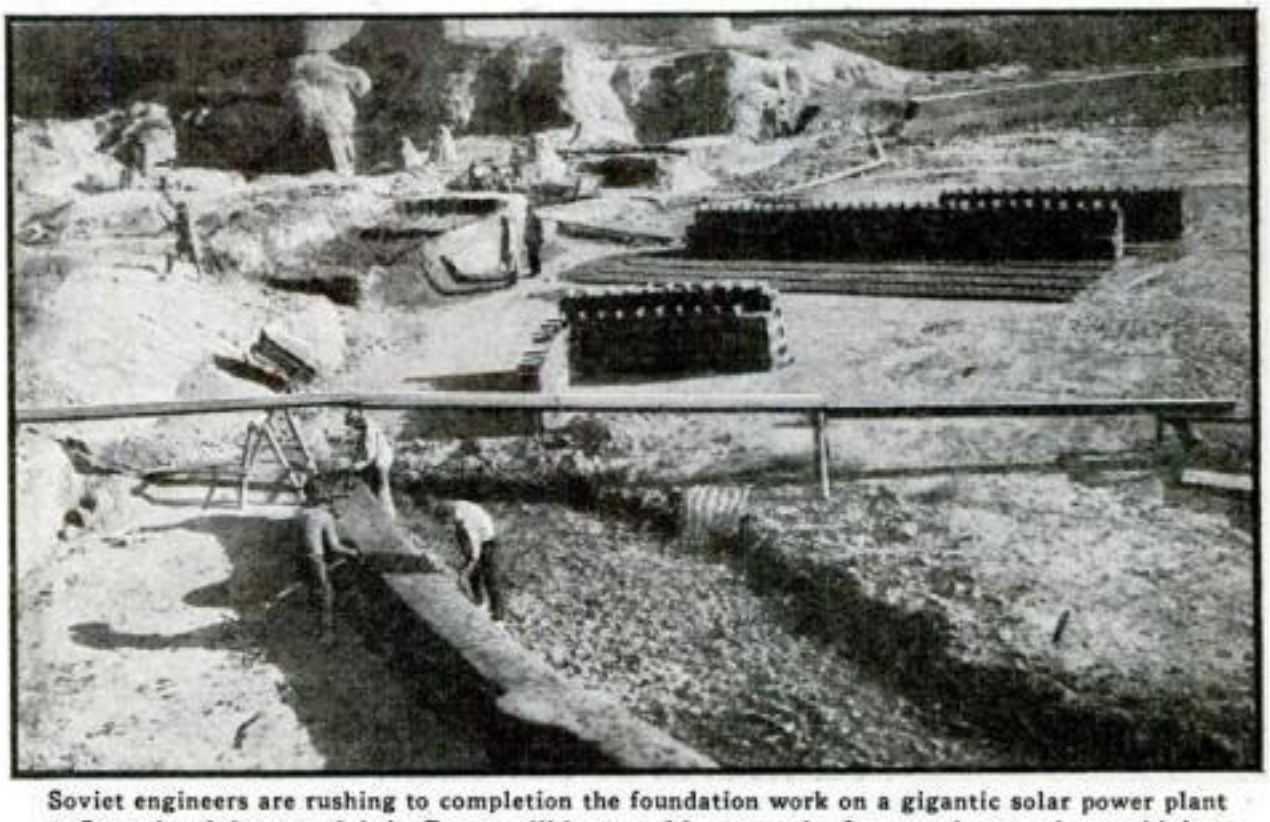
The fourth set of wheels on this armored car helps it over rough places.

OFFICE BUILDING WIRED FOR RADIO

FIRST large office building in the United States to make elaborate provision for the use of radio is a thirty-three-story structure now rising in Philadelphia. Each of its 425 offices will be wired for receiving programs. Special services to business are expected to be added by broadcasters. The new building will be planned to take advantage of them. Two antennas on the roof will supply programs to each office.

RUSSIA NOW BUILDING SOLAR POWER PLANT

ON A HALF-ACRE plot at Samarkand, in central Asia, Soviet engineers are rushing to completion a monster plant designed to harness the sun's rays for power. This solar power station will supply industrial plants with both hot water and electricity. During sunlight hours the solar rays will be used to heat water; the steam thus formed runs turbines, and the remaining hot water serves useful industrial purposes. The central part of the plant is a two-story building housing the turbines and heat reservoirs—the latter storing energy while the sun is not shining. The director of this experimental plant, Prof. M. Kosmind-Yushenkos, announces that an even larger one will be built if this station proves successful. Similar plants on the arid districts of the West, where the sun shines nearly every day in the year, have been suggested for this country (P. S. M., Nov. '29, p. 22).



Soviet engineers are rushing to completion the foundation work on a gigantic solar power plant at Samarkand, in central Asia. Power will be stored in reservoirs for use when sun is not shining.

18,000,000 Volts

Cable, Strung between Mountains, Acts

Dr. Kurt Urban, most shocked man in the world, on roof of Mt. Generoso lightningproof cabin.

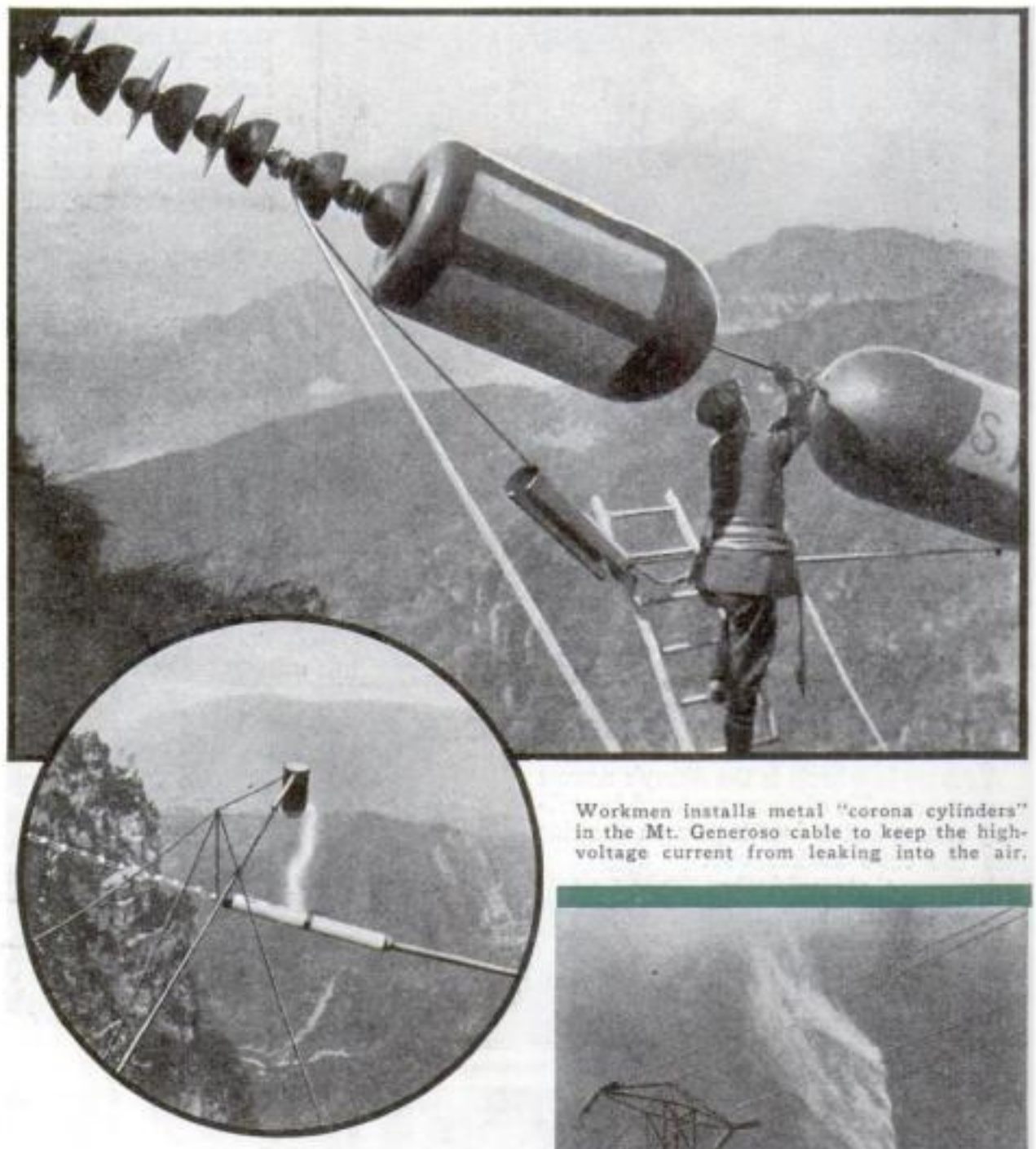
AT THE peril of their lives, three young Germans have just succeeded in drawing electric currents of 18,000,000 volts from the skies during a violent display of lightning. On the slopes of Mt. Generoso in Switzerland they duplicated Benjamin Franklin's famous experiment of catching atmospheric electricity with a kite and key, on a scale which that pioneer never dreamed of.

From the side of Generoso's bony-ridged slope, they stretched, as an aerial, a metallic cable across a chasm to a neighboring peak. Threaded through cylinders of galvanized metal, this antenna resembled a string of beads for a giantess. Its knobs were designed to keep the currents from leaping from the ends. Instead, an escape was provided in an adjustable spark gap, from which the electricity could be carried to a lightning-proof cabin sheathed with metal beneath the brow of the mountain. Here were meters and other instruments to gage the force of the electricity.

ONE day not long ago the daring three, Drs. A. Brasch, F. Lange, and Kurt Urban, of the University of Berlin, saw a storm of unusual intensity brewing. The sky became pitch dark. Peals of thunder hurried the scientists as they threw switches and tested instruments. Then with a rush of wind up the valley that almost swept away the aerial, the fury of the storm broke.

Tongues of electric flame played about the rocks of the mountain's face near the summit. Filled with metallic ore, it was a natural lightning rod. Great yellow sparks snapped every second across the spark gap. The pointers of the voltmeters within the cabin were doing a dance. There came a brief lull, ominous in its calm.

Suddenly a terrific thunderclap seemed to shake the whole mountain. The valley was lit up as by a million arc lights, and fantastic reflections danced over the white faces of the scientists. A bolt of flame crashed across the spark gap. For the first time, an eighteen-million-volt thunderbolt had been caught. The scientists had tapped the power of the lightning.



This apparently small spark is really one of several million volts, drawn from the sky, and leaping across a fifteen-foot gap in a preliminary test by experimenters at the Mt. Generoso station in Switzerland.

Workmen installs metal "corona cylinders" in the Mt. Generoso cable to keep the high-voltage current from leaking into the air.

High-voltage currents, knowing no bonds, do strange things. Here is an arc that is leaping between two high-tension wires.

NOW that they know how to obtain voltages infinitely greater than any man-made machine has been able to produce, their dream is to apply the titanic forces to an apparatus like an X-ray tube and see what will happen. The ordinary glass X-ray tube would have to be half a mile long, an impossible constructional feat, to withstand such electrical pressure. But the experimenters have already built a strange tube, less than a dozen feet long, of alternate rings of aluminum, rubber, and paper, that will stand electric forces up to 2,600,000 volts—by a considerable margin the most powerful ever made.

The rays from this tube far exceed in power those of all the radium in the world. They easily penetrate a wall of lead a yard thick, an impassable barrier to all ordinary X-rays. Next the experimenters plan to build a 7,000,000-volt tube of similar

Captured *from the* Sky

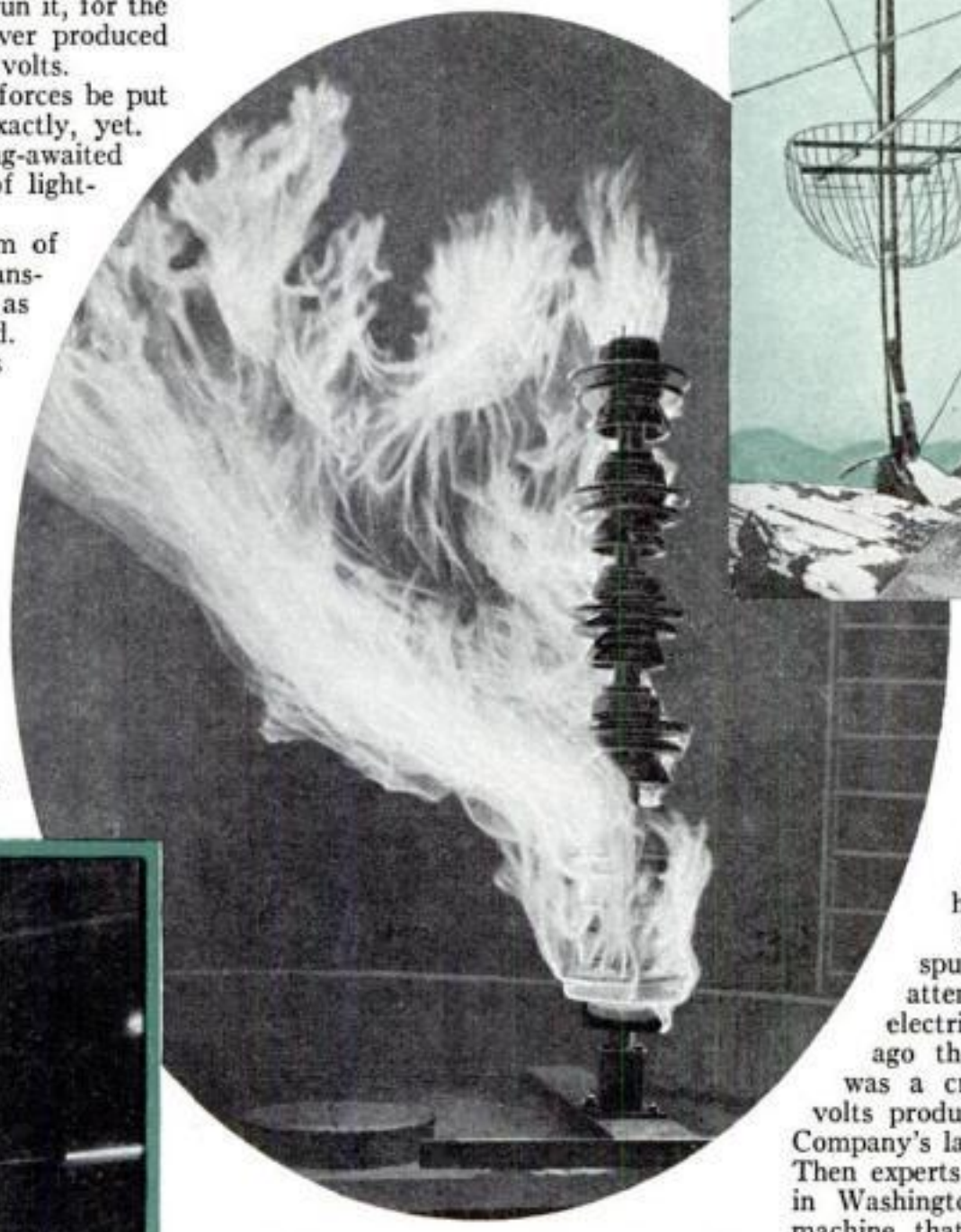
as Antenna to Gather up Lightning

design. Only lightning can run it, for the greatest electrical tension ever produced in a laboratory is 5,000,000 volts.

How can such staggering forces be put to use? No one knows exactly, yet. But there are several long-awaited tests for which the power of lightning may be tried.

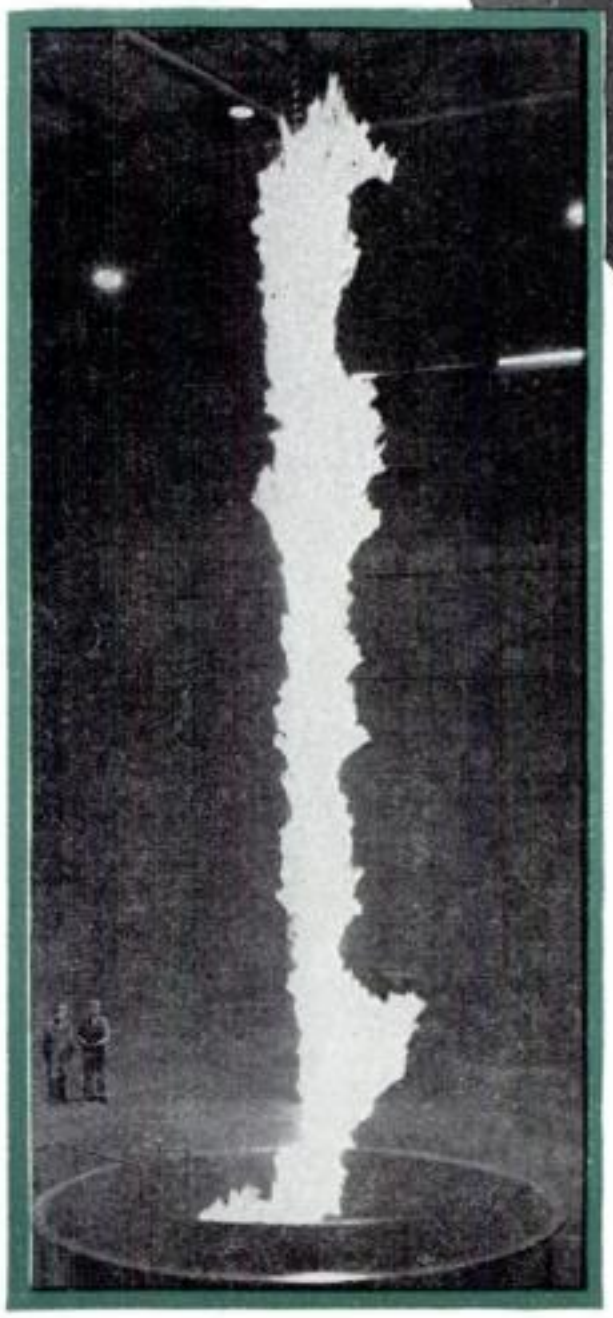
One of these is the dream of alchemists of old—the "transmutation of elements," such as turning base metals into gold. In recent years science has conceded that metals and other substances once held unchangeable can actually be transformed into entirely different ones under certain circumstances, requiring tremendous forces.

So far the only proved cases of transmutation have been done with the mysterious power of radium; thus, minute quantities of aluminum, phosphorus, and other things have been



This is not lightning, but a discharge of laboratory electricity leaping from insulators. It shows why extraordinary apparatus is required in harnessing 18,000,000 volts.

Here is part of the apparatus that was used in the Mt. Generoso tests. This strange network was designed to carry the enormous voltage to the laboratory where the scientists waited in danger of instant death.



This 55-foot man-made arc was drawn out in Westinghouse laboratory in recent test.

turned into hydrogen. Perhaps lightning's power may permit more useful transformations of other elements, when harnessed in a vacuum tube.

Then there is the question of unlocking the power of the atom. Some scientists hold that the energy contained in a single spoonful of water, for example, is sufficient to drive a modern steamship across the ocean. But this energy, if it does exist, is so securely locked up that no way has yet been found to release it. Should lightning's force break an entrance into this stronghold of power, the world might see a new era of industrial greatness based upon free atomic energy.

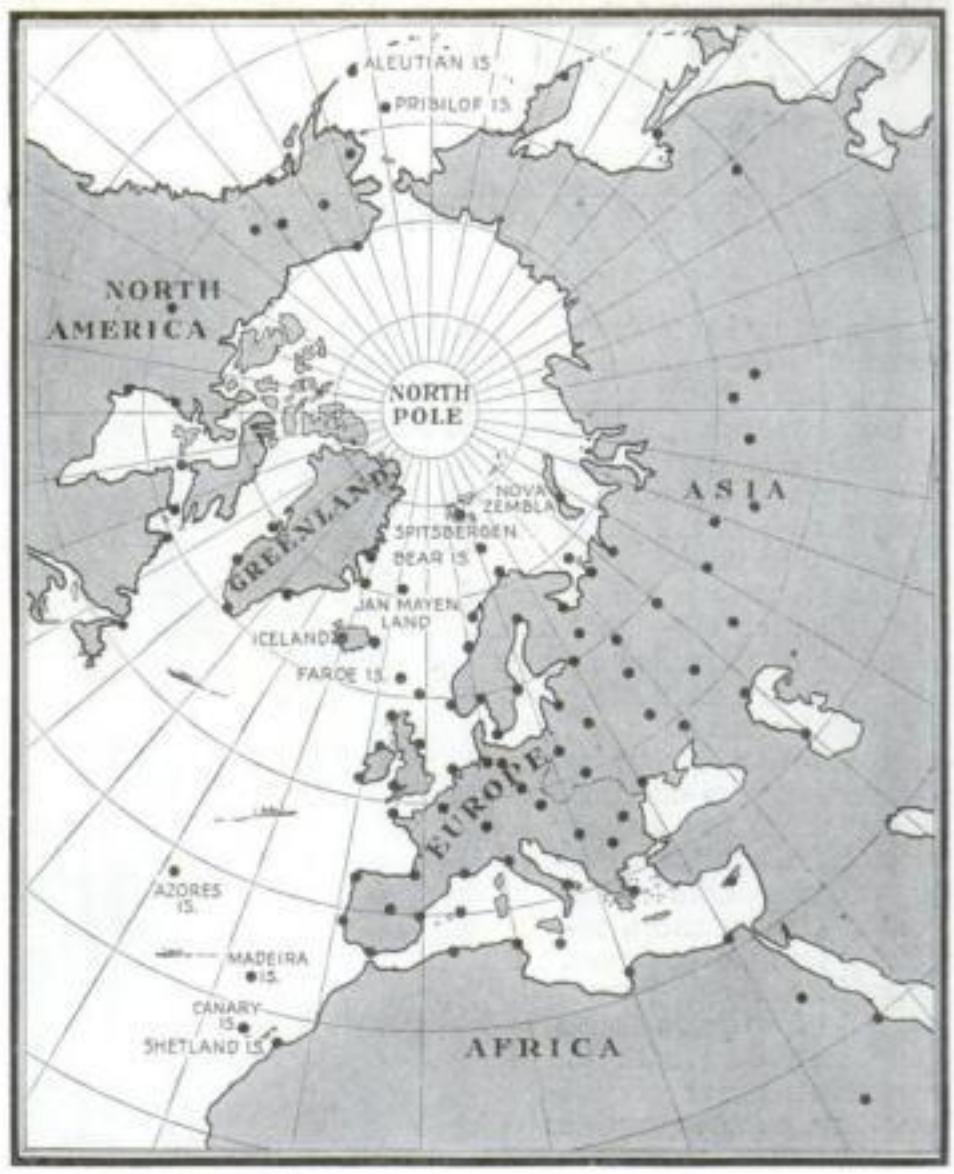
LASTLY, the rays from an electric tube operated by lightning's power may well have the most profound effect upon human beings. Whether beneficial or not, it is too early to say. Perhaps the audacious experimenters will find a curative ray more effective against cancer than any instrument hitherto known to science. On the other hand it may be a "death ray."

Such fascinating possibilities spur man's advance in his attempt to harness stupendous electric forces. Only a few years ago the pinnacle of these efforts was a crackling spark of 3,600,000 volts produced at the General Electric Company's laboratory in Pittsfield, Mass. Then experts at the Carnegie Institution in Washington, D. C., built a mighty machine that could command 5,000,000 volts. Meanwhile the German experimenters had already installed a preliminary apparatus on Mt. Generoso, a peak famed for the frequency and violence of its electric storms, and were drawing two-million-volt sparks (P. S. M., Jan. '29, p. 23). A higher, rebuilt antenna made their recent feat possible. One of the experimenters, Dr. Urban, has acquired the sobriquet of "most shocked man in the world" from being knocked unconscious by sky currents.

IT MUST be understood that their antenna is not directly struck by lightning, for if it were, despite an electrical "safety valve" they have provided, they would probably all be killed. The aerial takes current from the clouds in two ways. Electricity in the air itself leaks down the cables in steady sparks. But the greatest voltages are obtained when a lightning bolt passes close to the aerial and a sympathetic surge of electricity is induced in the wire. In this way they have now captured 18,000,000 volts, and even greater voltages, up to thirty million, are in sight!

Europe and America Unite to Broadcast Weather Reports

For the first time, American and European weather stations have joined in an international hook-up to aid mariners. Through this new service the captains of vessels receive, by radio, weather information collected over the entire hemisphere and broadcast from the Naval radio station at Arlington, Va. The reports permit two weather maps to be drawn on shipboard daily. Thus the skipper may avoid storms and pilot his ship in safety. Three sources supply material for weather forecasts—vessels at sea, North American weather stations, and European observatories. The latter reports are collected and transmitted to the United States by the British radio station at Rugby. At present the skipper of a vessel, receiving data from the Arlington station, prepares his own weather maps upon blanks furnished especially for the purpose. However, experiments are being made at broadcasting actual weather maps, just as pictures are transmitted by radio. They were begun last year (P.S.M., Oct. '30, p. 22), and the success so far obtained suggests that vessels of the future may get their weather information this way.



Each of the black dots on this map represents a station that sends weather reports to Arlington, Va., whence they are radioed to ships.

"TANKS" ARE ARMORED CARS

When is a tank not a tank? Germany's answer is the fleet of queer vehicles shown in this photograph. Each is built on a special automobile chassis, carries a gun of small caliber, and is manned by a crew of four men wearing crash helmets. Technically it is classed as an armored car and not as a "tank." Under the terms of the Versailles peace treaty, Germany is forbidden to build war tanks. Dummy tanks of wood have taken their place for practice maneuvers (P.S.M., Aug. '31, p.50).

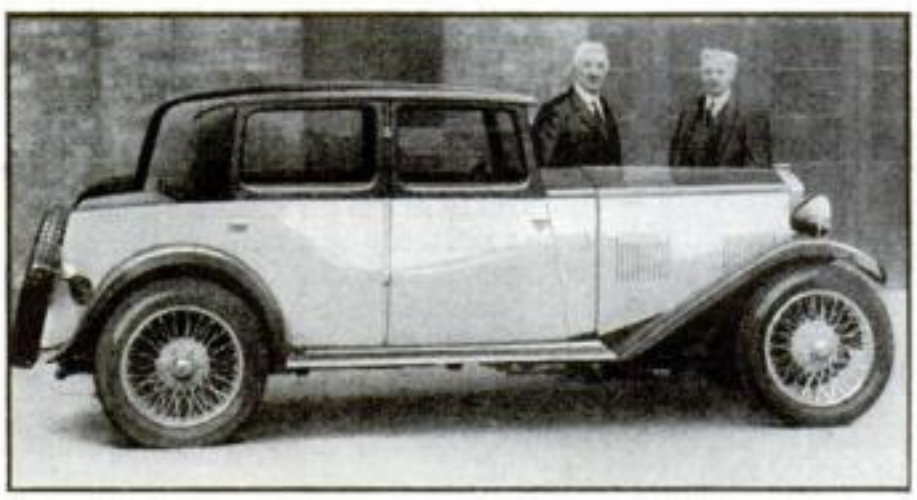
SCUTTLED LINER SINKS AS CAMERA SNAPS

From a perilously close point of vantage, a photographer made this remarkable camera study of the last plunge of the Australian steamer *Wodonga*. The occasion was her burial at sea after a long and distinguished service. In 576 trips the liner covered more than 4,000,000 miles. Salvagers stripped her of everything of value, and the bare hulk was scuttled off Sydney Heads, Australia.

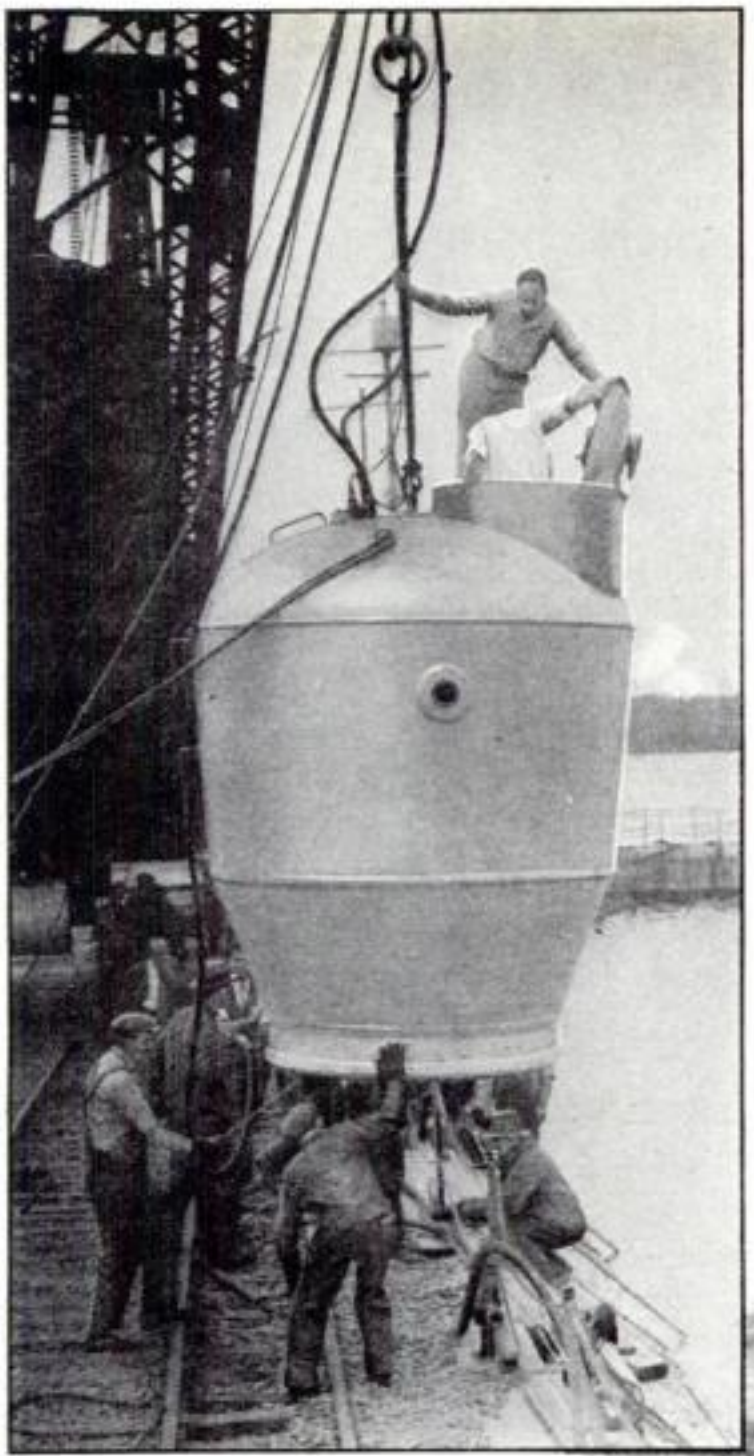
This remarkable photograph shows the end of the liner *Wodonga*, sunk after 576 voyages.

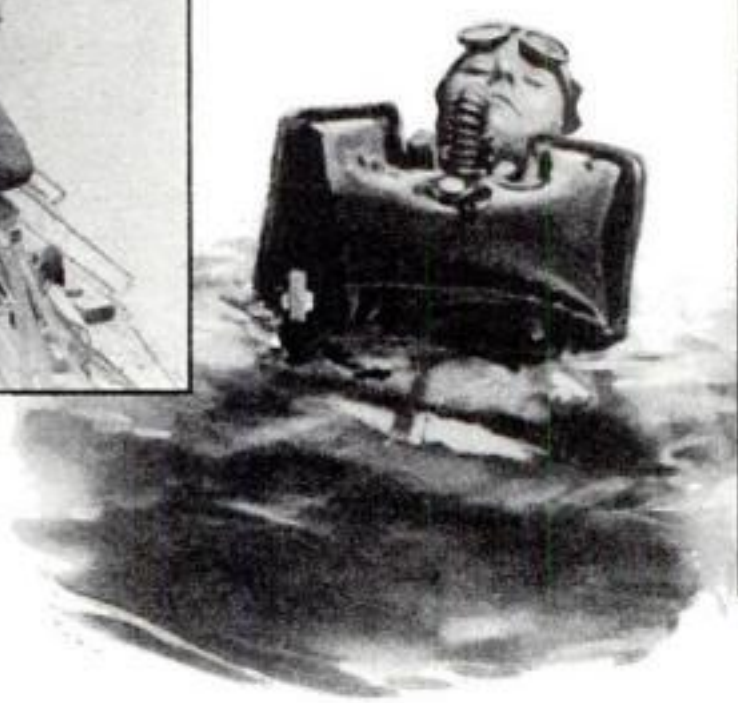
ENGLISH CAR HAS ASBESTOS BODY

Here is the first picture of the new "asbestos automobile" built in England, of which an advance report appeared in the July issue of Popular Science Monthly. The original car so equipped has just passed its experimental tests in which leading motor car and bus companies are coöperating. Although it resembles a standard sedan in outward appearance, the fireproof body of this car is completely made of asbestos. Engineers have succeeded in making thin plates of this material that are durable, lighter in weight than steel, and which will take satisfactorily the enamel paints used on motor cars.



TRAPPED MEN ESCAPE FROM SUB





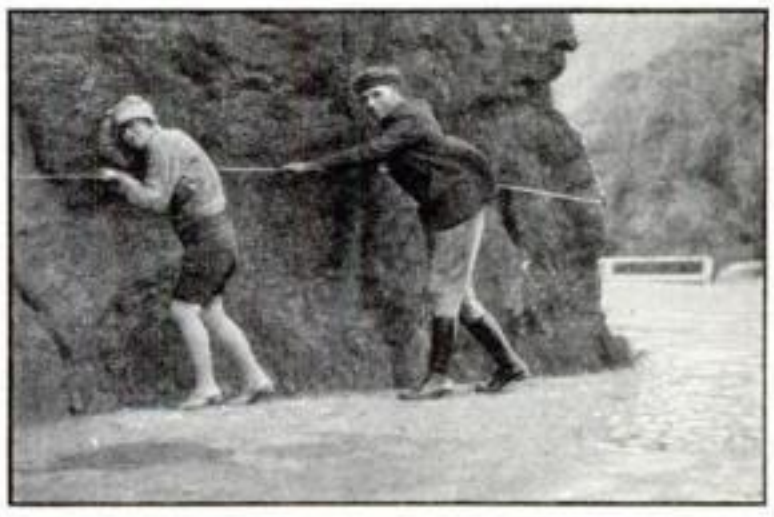
Above, the United States Navy's new diving bell designed for use in rescuing sailors trapped in a sunken submarine. Twenty men at a time can rise in it to the surface. At right is the Davis lung which is used by the English navy and with which six escaped from the rammed *Poseidon* in the Yellow Sea near China.

This photo gives a view through the window of the new United States diving bell, showing rescuers and telephone to talk to ship.

When the rammed British submarine *Poseidon* went down in the Yellow Sea off the Chinese coast, six of its trapped crew probably became the first to escape from a sunken undersea craft without outside aid. First, they donned Davis "lungs," a recently invented type of oxygen mask combined with a life-belt and eye-protecting goggles. Then, one by one, they made the hazardous plunge for life through a flooded hatch. The first man bobbed to the surface two and a half hours after the accident. Others followed at intervals of a few minutes, and rescuers assembling on the spot picked them up. Two of the men later died of their injuries, and one was in grave condition at this writing, but at least three won their desperate gamble against death. Meanwhile the United States Navy was making ready to test its newest submarine rescue device at New London, Conn. For months it has been experimenting to find the most practical way of reaching imprisoned victims of a submarine accident. The result is a unique diving bell manned by two operators. It descends along a guide line to the disabled submarine and attaches itself like a barnacle to the hull, by vacuum and sea pressure, over one of the two escape hatches that all undersea boats provide. It can carry as many as twenty men to the surface at once. If the escape hatches cannot be reached, the men in the bell can cut a hole into the submarine's hull with underwater torches and free the occupants. The submarine *S-4* with a crew aboard will descend 600 feet off New London to test the new steel "pineapple." First a diver will go down to attach the guide cable to the sub. Then a winch within the bell itself will haul the chamber down to the submarine, to which it will be fastened while the crew is "rescued."

LIGHT ON HEAD AIDS WORKMAN

So that installers of electrical apparatus may have both hands free for work in dark places, a new "inspection lamp" resembling a miner's headgear may be worn on the forehead. It is held in place by a rubber headband. Current is supplied through a cord hanging down the wearer's back, with a special connection that parts instantly at any sudden strain. Either current taps or batteries may supply electricity for the twenty-watt bulb, whose light is concentrated by a reflector in a powerful beam. With a movement of the head a workman is able to aim the beam of light.



WINDIEST SPOT GETS CABLE

One of the windiest spots in the civilized world is Pali Pass, near Honolulu, where a motor road crosses a mountain ridge. After numerous accidents to pedestrians, authorities have now strung a steel cable to aid those traversing this natural wind tunnel on foot. Trade winds blow constantly, often at a hundred miles an hour. Motor vehicles can round the corner against the wind only in low gear. Walkers are often unable to move against the wind.

Nine years ago Frank Fasano bought this two-acre farm at Chula Vista, Calif., for $2,000. Today it pays an income of $2,000 a year with every foot under intensive cultivation. Recently he refused a $15,000 offer for it.

Midget Farmers *Beat Hard Times*

Six Thousand Men and Women in California Make Yards Pay for Their Homes While Holding Other Jobs

By H. H. DUNN

NINE years ago, Frank Fasano and his wife paid $200, their combined savings, on a purchase price of $2,000 for two acres of land in Chula Vista, Calif. Frank had a job in town that paid $35 a week. For six months, the Fasanos used some of this pay check to prepare their land.

Since that time, this land has paid the annual instalments on the purchase price, the interest on deferred payments, built a five-room, modern house, and converted every foot of the two acres to production. The pay check has gone for living expenses, an automobile, entertainment, and other costs of living.

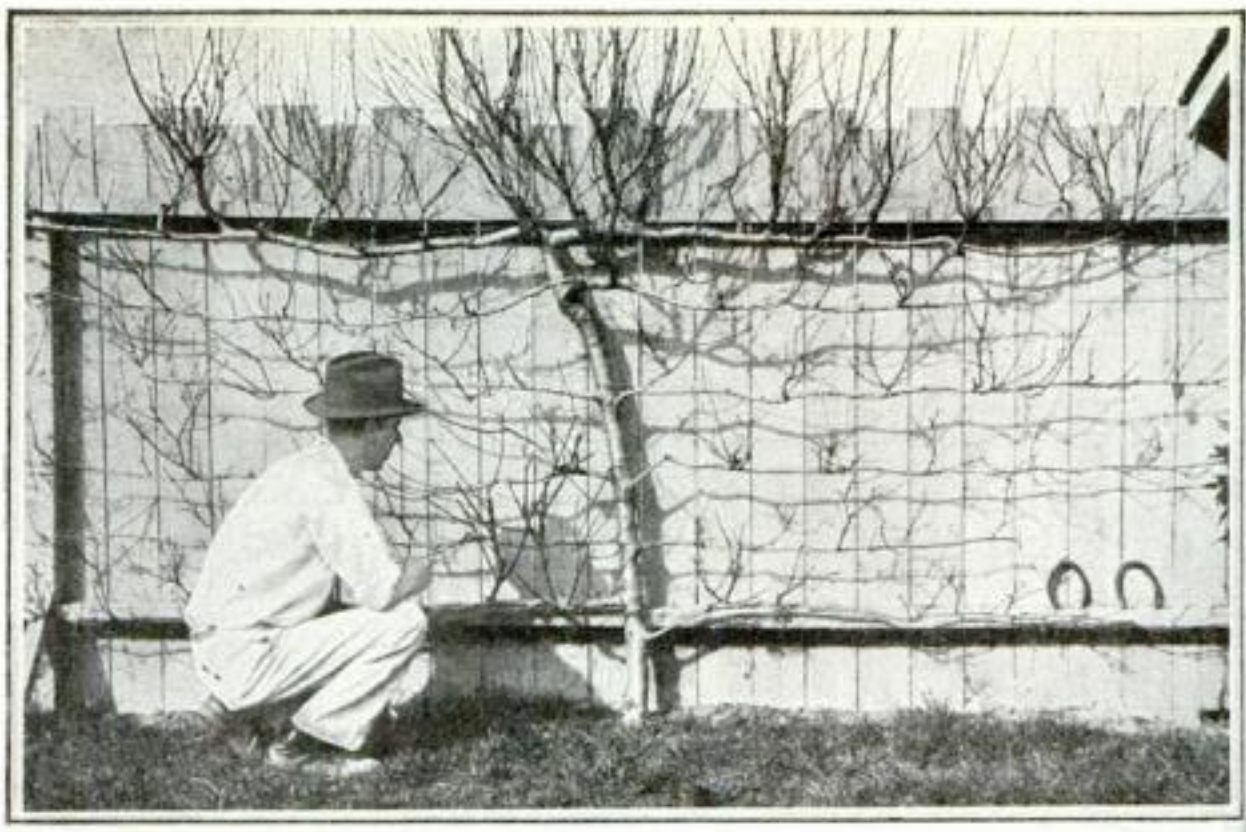
The Fasanos have refused $15,000 for their place, which pays them $2,000 a year.

Mrs. Pearl Evans, left a widow with two small sons, bought two acres of bare land, at the village of Muscovy, Calif., a little more than a year ago. She works six hours a day, six days a week, on the midget farm, while the boys average three hours a day each. The place produces all the chickens, eggs, vegetables, and small fruits the family of three can eat, and has paid the monthly instalments and interest on the purchase price. In addition, the two acres provide room and food for 600 laying hens and nearly 1,000 half-grown chickens.

On the tiny ranch everybody works, including father, and that is the real secret of its surprising success. Upper left, dry-land geese that require no swimming pond are raised on the midget farms.

THESE are two examples from more than 6,000 families in southern California who have learned how to make the yard pay for the home. They are all in towns or cities or in the suburbs, for the great majority of them must be within easy reach of transportation to and from their jobs. Some of them who have been at this new business of making a home pay for itself for ten years, now own their homes, and the yield from the midget farm is net profit, less taxes and upkeep.

Many of them, like the Fasanos, have brought their midget farms to such condition that they are in a position to retire from their daily employment and live, with an average of sixty to eighty hours' work a week, on their own ranches.



Room is precious on the tiny farms, and as a result fruit trees, like the peach tree shown here, are trained flat against a wall. In this form more sunlight reaches them, increasing the yield.

At right, women as well as men can work these one-acre ranches, and here one is pruning the blackberry vines that pay interest on the mortgage. Below, terracing on a small farm to raise avocados and tangerines.

Most of the 6,000 have been following the plan for only a short time, and still more are trying it every year. Bankers estimate that the failures have averaged less than six to the thousand, or about one to every 165 families.

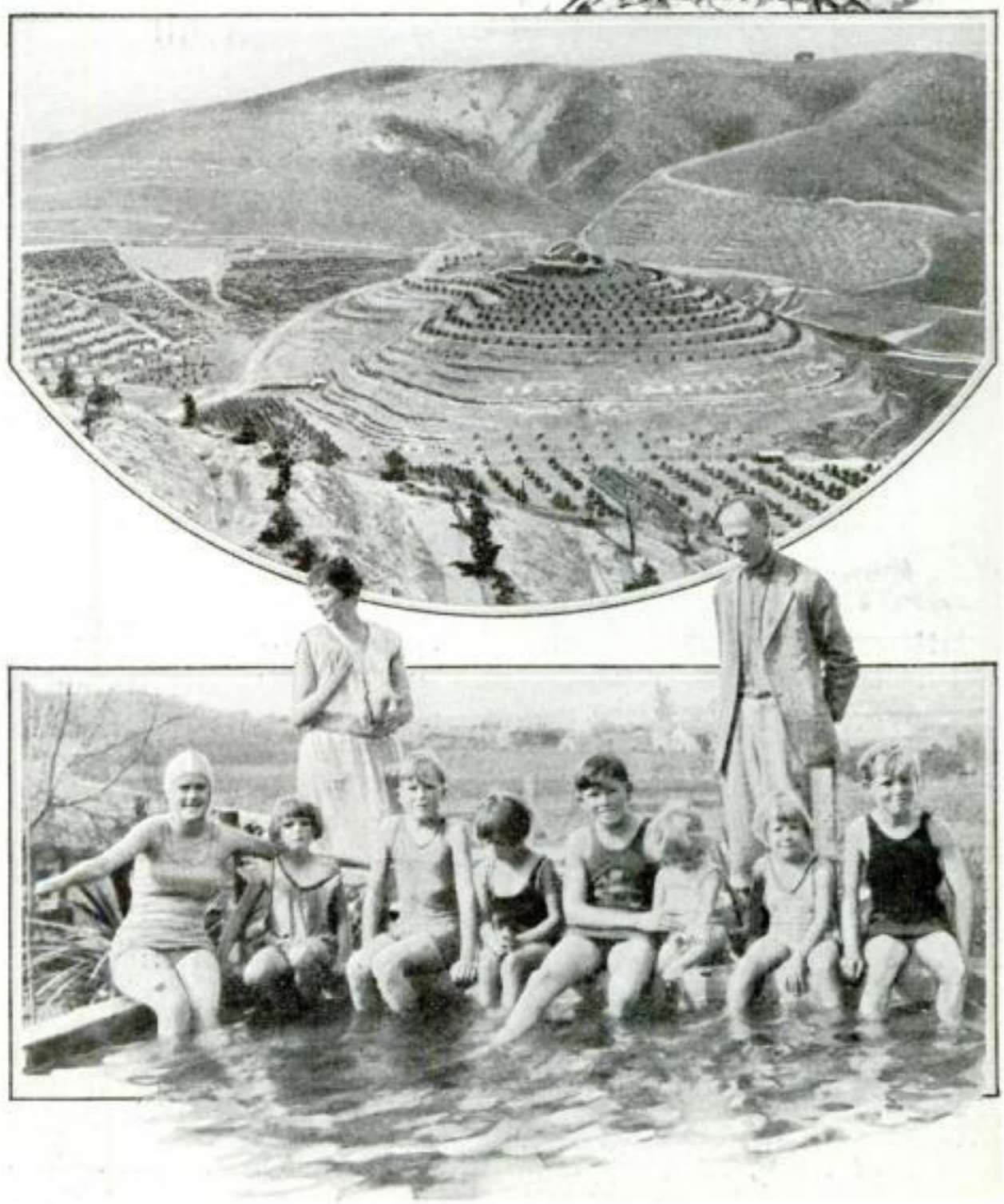
There is no colonization project, no employers' aid, and no small-farm-tract scheme in this widespread economic success. The 6,000-odd midget-farmers are scattered through more than fifty cities and towns, each on land of his or her own purchased independently, and developed along nearly a score of different plans of production to meet the costs of the farm.

SOME of them have been able to make successes on one large city lot, but the great majority buy from one half acre to two acres, the average being one "commercial acre"—that is, a standard acre less allotments for sidewalks, curbs, and alleys.

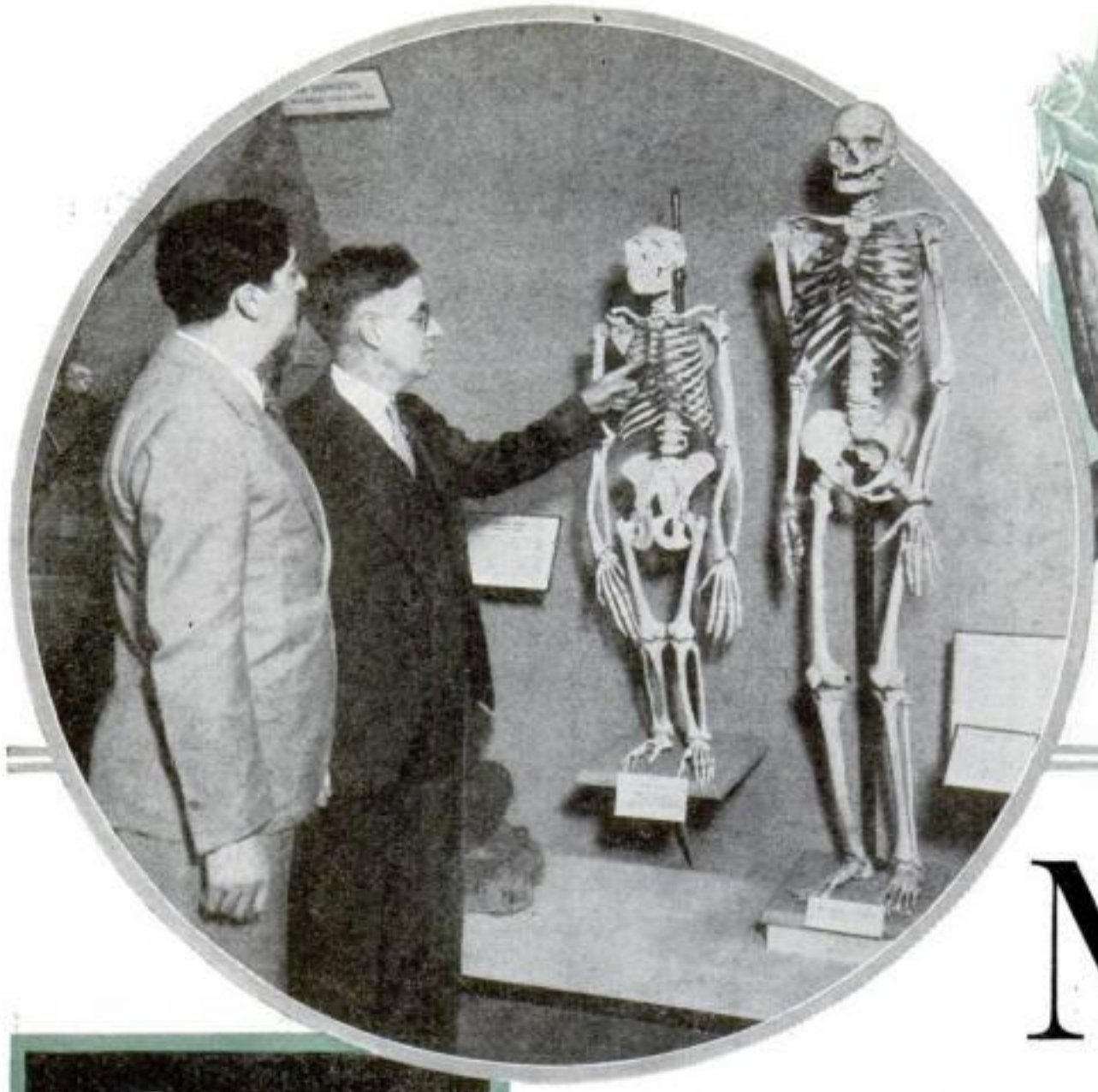
Probably ninety-five percent of these working farmers have had no previous experience as agriculturists, horticulturists, or poultry raisers. In the selection of soil and location, and in the choice of crops for each farm, they have the technical assistance of the agricultural department of the chamber of commerce at Los Angeles, a bureau organized for this purpose when the commercial organization saw the extent to which this movement was developing.

On application by the prospective purchaser, this department sends soil experts and appraisers to the land. The expert makes a full report as to character of soil, what it will produce, crops best adapted to it, irrigation and drainage conditions, and the kind of fertilizers to be used. Then the appraisers tell the would-be buyer just what the land is worth and what he should pay for it.

No real estate dealer has any connection with this department or influence with it, a fact that has had a great deal to do with the success of the midget-farmers. In addition, the state department of agriculture gives the home owners free information *(Continued on page 118)*



Primarily this is not a swimming pool, though it obviously is going to be used for that purpose by the children of the family. Really it is the irrigation reservoir that waters this midget farm.



This spectral tarsier, a strange monkeylike creature with big eyes, still lives in Borneo and in the Philippines.

MAN *Is*

Above, Dr. Gregory is pointing to the sternum of the chimpanzee to emphasize its similarity to the human breastbone. At left, side view of skeletons of man and a chimpanzee. Note more erect posture of the man and "S" shape of his spinal column.

What They Talked About

DR. WILLIAM K. GREGORY, the distinguished scientist of the American Museum of Natural History, has told Michel Mok, staff writer, how the earth and life originated, and how man got his face and other bodily parts. Life appeared a billion years ago in mud and puddles in the shape of tiny bits of jelly, probably the products of ancient chemical forces, which developed into cell-groups, into small wormlike creatures, into air-breathing fishes that became our ancestors. Last month, Dr. Gregory traced the origin of our digestive tract, lungs, blood stream, heart, and other organs, all of which we inherited from early animal ancestors and many of which are almost 500,000 years old.

MR. MOK: Dr. Gregory, you told me last month that we got our upright position from the monkeys. You subscribe, then, to the theory that we are descendants of monkeys?

DR. GREGORY: That is no longer a theory, but an established fact. We are not only descendants of monkeys, but we still *are* monkeys. To complete the collection in the monkey house at any zoo, there should be a man behind the bars. As it is, the only monkeys not in cages are the spectators and keepers.

MR. MOK: I am afraid you would have a hard time finding a volunteer. People are too modest. Everybody would concede at once that the other fellow was a finer specimen. But I suppose you are only joking?

DR. GREGORY: Indeed, I am not. I am stating a scientific fact. When a man is watching an inmate of the monkey house, you have representatives of two species of monkeys looking each other over. Both are actuated by one of the outstanding traits of the monkey family —curiosity.

MR. MOK: Of course, I am familiar with the idea that we may have descended from monkeylike ancestors. But why do you say that we are still monkeys? That idea is new to me. Whose is it—Darwin's?

DR. GREGORY: Most people associate it with Darwin because he put it "on the map," so to speak. But it is much older. In 1759, just half a century before Darwin was born and precisely one hundred years before he published his famous book, "Origin of Species," Linnaeus, the great Swedish scientist, discovered that man was a mammal. In fact, it was he who coined the word mammal as a name for the animals that bring living young into the world and suckle them. He then placed man in the Order of Primates, which means literally the first, or highest, order of mammals. It comprises all the monkeylike forms, including the manlike apes.

MR. MOK: But Linnaeus might have been wrong!

DR. GREGORY: He might have been, but he was not. Nothing has happened since 1759 to take man out of the Primate group. On the contrary, literally thousands of facts have been found that prove Linnaeus' contention. That is why I said we still are monkeys.

MR. MOK: What are those facts?

DR. GREGORY: I will come to them after a while. First, I want to tell you something of the origin of the idea. Even in Linnaeus' time, the theory, in a general way, was by no means new. The idea of evolution usually is credited to Lucretius, the Roman poet, who lived in the first half of the first century B.C. Do you know what is meant by evolution?

MR. MOK: The development of all living things from lower forms.

DR. GREGORY: Not all. The evidence shows that the progress generally has been from the simpler toward the more highly organized and specialized types, but the opposite also has occurred. Evolution simply is the Latinized version of the

Ioni, an intelligent chimpanzee, is busily engaged in matching colors under the direction of Mrs. N. Kohts, Russian authority on animal psychology. The test indicates that apes have eyes like man's, that can distinguish colors.

From The Great Apes, *by Robert M. Yerkes, Courtesy Yale University Press*

SCIENTIFIC ***facts in the history of human beings are told in this dialogue in which is continued the story of*** **LIFE...the World's Greatest Mystery**

Dr. Gregory: **I see you have been looking at the funny pictures in which stone age men are chased out of their caves by dinosaurs. But all those huge reptiles had died millions of years before man was man.**

Still a Monkey

word unrolling or unfolding. The theory of evolution, therefore, teaches that life unfolded slowly instead of having been produced suddenly. Lucretius first suggested the idea of creation by necessity rather than by special decree of the gods.

MR. MOK: If life appeared by evolution, why is it not continuing to be produced in that way?

DR. GREGORY: Life *is* continuing to evolve, as it has in past ages, and at the same extremely slow pace. Don't forget that it took more than a billion years to create man! (P. S. M., June '31, p. 17.)

MR. MOK: What is the animal just below man?

DR. GREGORY: The chimpanzee.

MR. MOK: Do you mean to say, then, that, given enough time, the present chimpanzee will evolve into man?

DR. GREGORY: Certainly not. First, man did not evolve from a chimpanzee, but from a common ancestor of both chimpanzee and man, as I will explain later. Secondly, Nature never repeats itself in the creation of a new species, and it already has produced man.

MR. MOK: To come back to Lucretius—was his idea forgotten until Linnaeus took it up again?

DR. GREGORY: Not exactly. In 1699, Edward Tyson, an English anatomist, dissected an ape specimen, now known to have been a chimpanzee, and showed that its anatomy closely approached ours. But he did not establish any relation. This was first done by Linnaeus. After that came Lamarck, the French naturalist, who died in 1829. He was Darwin's immediate predecessor both in the general theory of evolution and in the idea that man derived from an upright-walking ape. This idea was so distasteful to many people that other French scientists put man in an order by himself, which they called *bimana,* meaning the two-handed.

MR. MOK: Then Darwin, you might say, was a disciple of Lamarck's?

DR. GREGORY: No, he paid little attention to Lamarck's work. At first, he did not even devote himself to the subject of man. For many years, he made an exhaustive study of animal and plant life. When he did take up the subject of man's place in Nature, he reached his conclusions independently through first-hand study of the facts.

MR. MOK: As I understand it, these evolutionists, from Linnaeus to Darwin, taught that man is descended from a monkey or a monkey-like animal.

DR. GREGORY: Yes, and we still do.

MR. MOK: How did they know?

DR. GREGORY: Because of the structural resemblance between man, the apes, and the monkeys. As a matter of fact, the anatomy of a manlike ape is more like ours than like that of the lower monkey forms. I have explained to you that structural resemblance proves relationship (P. S. M., July '31, p. 24).

MR. MOK: You have. But does it prove descent? How do you know that there were no men on earth long before the monkeys?

DR. GREGORY: Are you hinting that the monkeys are descended from man? Some scientists have seriously entertained that idea, just as some have tried to show that the fishes were descendants of land animals rather than the reverse. I regard that as a first-class example of a topsy-turvy view of things. If it were true, then man would have been the first creature on earth, and all the simpler forms would have been derived from him.

MR. MOK: I was not hinting at such a possibility. What I would like to know is this: Why may there not have been men, say, in the age of the reptiles?

DR. GREGORY: Ah, now I see what has happened. You have been looking at those funny pictures in which stone-age men are chased out of their caves by dinosaurs. But all those huge reptiles had disappeared for scores of millions of years before man became man.

MR. MOK: What makes you so sure? Why may there not have been men around in any age, no matter how early?

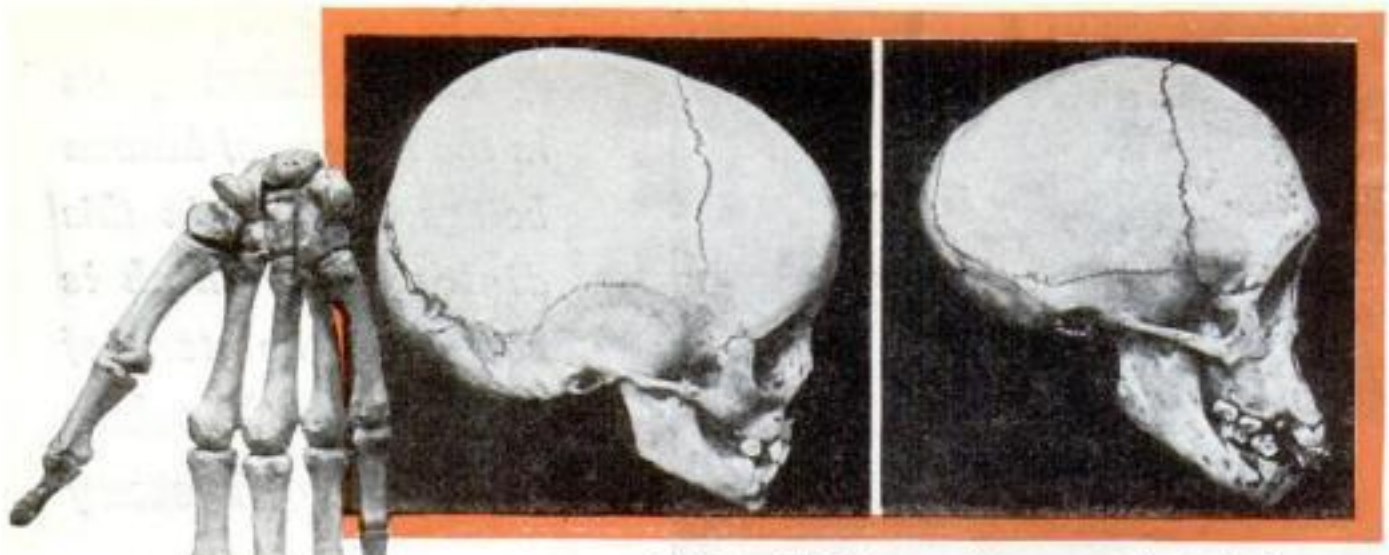
DR. GREGORY: The "why-may-not" style of argument never proved anything. It is used mostly by those who wish to dodge the direct evidence of scientific facts.

MR. MOK: I assure you I have no such wish. What is your direct evidence?

DR. GREGORY: You are convinced that man is a backboned creature, aren't you?

MR. MOK: He should be.

DR. GREGORY: Fine. We have a life record of the backboned animals stretching back over a period of something over



At left, skull of human infant; at right, skull of young chimpanzee. The parts of the human skull have the same structure as those of the ape, the difference being due to brain expansion and shortening of man's face.

Note that hand of man, above, and of chimpanzee, right, are identical, bone for bone, and differ only in their proportions.

four hundred million years. True, this record is broken, at intervals, but still we have tens of thousands of specimens, actual fossils from hundreds of localities and representing scores of successive stages in the history of the earth.

MR. MOK: What good is this huge mass of old bones in proving that man followed the monkeys and not, say, the early fishes?

DR. GREGORY: Because in each rock layer, dating from some definite age, fossils of certain creatures were found and others were not.

MR. MOK: In other words, because no human bones were unearthed from the same rock layers that contained, for example, early reptile fossils, you conclude that there were no people at that time. I call that negative evidence. You merely infer it.

DR. GREGORY: Right. So far, it is an inference from negative evidence. But everything we know in science, except that which is directly observed, is known by inference. It is in that way, for instance, that we know that the sun does not actually rise and set, but that the earth alternately produces day and night on either of its hemispheres by whirling around its own axis. Nobody ever has seen the earth whirl. In daily life and law, the same thing holds good.

MR. MOK: For example?

DR. GREGORY: My ancestors came from Devonshire, in England. Let us suppose for a moment that a sum of money is left to me because I am the last of my name in the male line. Just as I am about to claim my inheritance, up bobs a chap named Gregory, who says he comes from a certain town in Devon, is my cousin, and demands half the estate.

MR. MOK: What has that to do with the monkeys?

DR. GREGORY: One moment, please, and you will see. I never heard of the fellow, so I have him looked up in that place in Devonshire. There is no mention whatever of him there in the directories, municipal and church parish records, tax records, and the like. That is negative evidence that he did not come from Devonshire. But that is only half the story.

MR. MOK: Don't tell me he is your cousin, after all!

DR. GREGORY: Far from it. While one of my private detectives looks him up in Devonshire, another clever sleuth discovers that a man of that age, and answering my "cousin's" description in every detail, lived in a small town in Poland until ten years ago. His name was Gregorowski. He changed it to Gregory. What would you call that?

MR. MOK: Positive evidence.

DR. GREGORY: Exactly. So then I have, first, negative evidence that he was *not* born in Devonshire, and, second, positive evidence that he *was* born in Poland. Well, we have a similar situation in this business of man's place in the history of life. We have negative evidence that he did not live, for example, in the age of the dinosaurs, and positive evidence that he did live scores of millions of years later. Is that clear?

MR. MOK: Clearer than it was before. Still it seems to me that your anecdote does not fit the case exactly. Suppose all the municipal and parish records in the Devonshire town had been destroyed in a fire? What I mean is this: Is it not possible that no human remains were found in the earlier rock layers because of earthquakes or other upheavals?

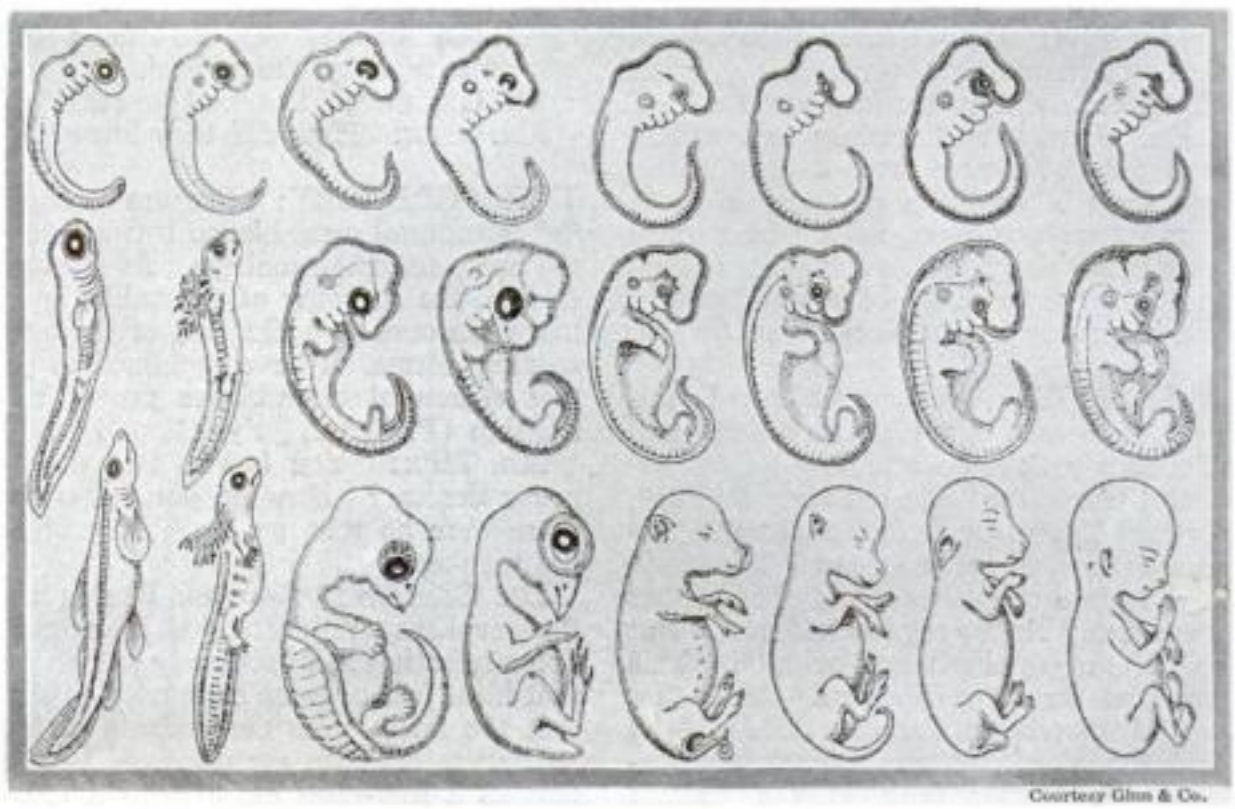
DR. GREGORY: That would not cause them to be consistently absent for nearly four hundred million years, and consistently present in much later periods. In this one museum alone (The American Museum of Natural History—Ed.) there are no fewer than 44,661 catalogued fossil specimens of backboned creatures, and not a single one of them was found in a rock layer in which it did not belong chronologically. A broad view of the fossil record of life, of which this collection is only a very small part, shows that the general trend of life's development was from fish to man, and not the reverse. That being the case, man followed the monkeys.

MR. MOK: Can you prove this specifically?

DR. GREGORY: Certainly. Fossil remains of men have been found in recently formed rock layers. From older rock layers have come fossils of apelike men. In still older rock layers have been found fossil fragments of manlike apes. Rock layers more ancient still have yielded remains of small apes. In layers formed before that time, not a trace of apes has so far been discovered, but fossils of small monkeylike creatures have been found in them. Now, this is the evidence of the rocks. Evolution, however, is supported by three kinds of evidence.

MR. MOK: What are the other two kinds?

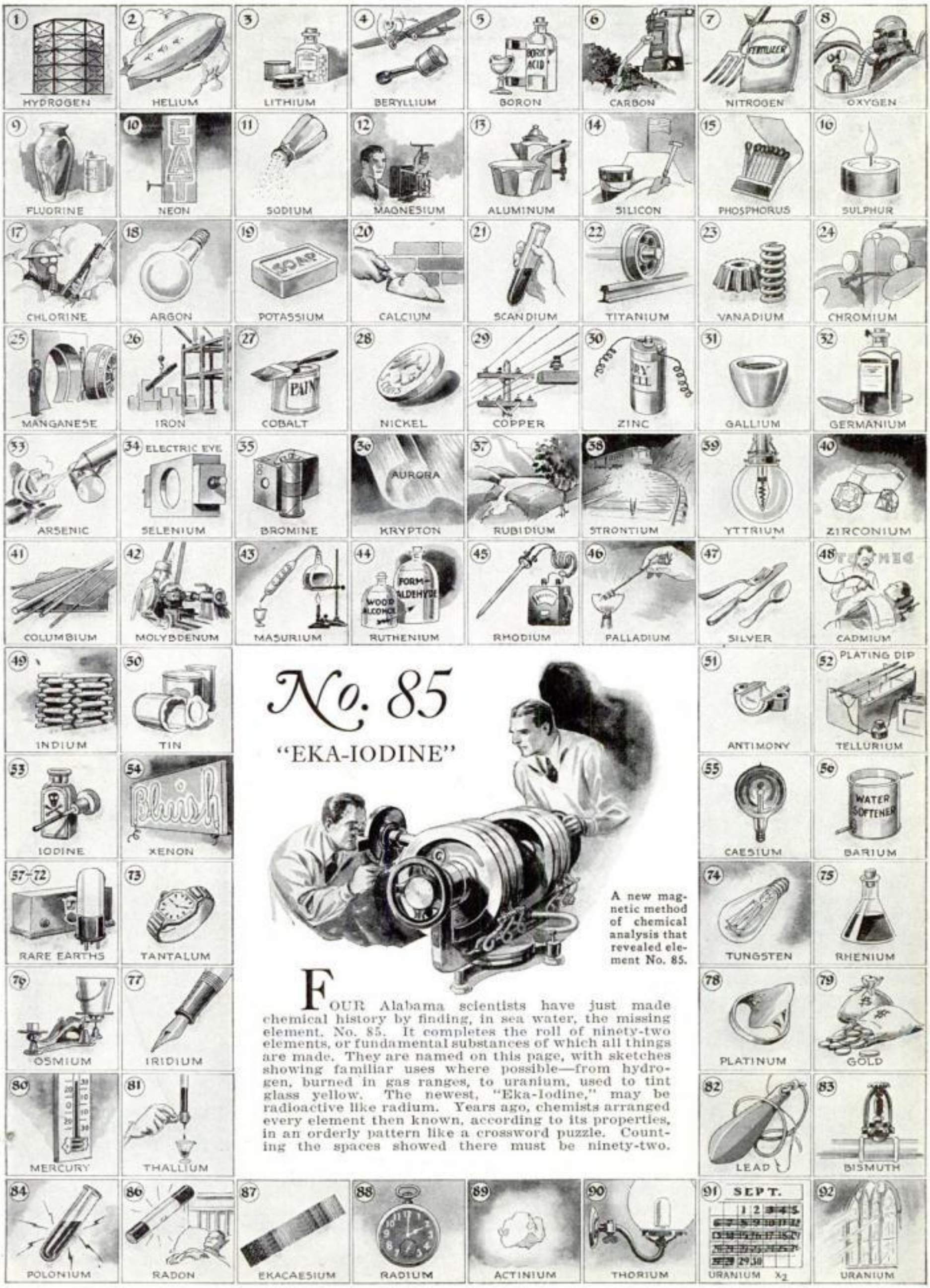
DR. GREGORY: The evidence supplied by the study of the structure of animals, particularly as it shows their relation to each other and *(Continued on page 114)*



Courtesy Ginn & Co.

These embryos are, reading across from left to right, fish, salamander, tortoise, chick, pig, sheep, rabbit, man. Development increases from top to bottom.

Last of the ELEMENTS *Discovered*



FOUR Alabama scientists have just made chemical history by finding, in sea water, the missing element, No. 85. It completes the roll of ninety-two elements, or fundamental substances of which all things are made. They are named on this page, with sketches showing familiar uses where possible—from hydrogen, burned in gas ranges, to uranium, used to tint glass yellow. The newest, "Eka-Iodine," may be radioactive like radium. Years ago, chemists arranged every element then known, according to its properties, in an orderly pattern like a crossword puzzle. Counting the spaces showed there must be ninety-two.

By
MARSHALL
ANDREWS

Occasionally a bear turns outlaw and becomes a killer, slaying his prey with a single blow of his mighty paw. Usually a trap set near a carcass will end the big marauder's career.

Mountain lions, cunning and wary, take a heavy toll of western livestock each year. Government agents find it hard to control the depredations of these animals that avoid poison, guns, and traps and seldom return to scene of kill.

War Declared *on*

Wolves, Coyotes, Bobcats, and Rats

"IF YOU don't help us quick, everybody in this section will be ruined before fall."

Letters like this, often as not scrawled in pencil on ruled tablet paper, come almost daily into the field stations of the Predatory Animal and Rodent Control of the Bureau of Biological Survey.

Somewhere in the territory, farmers or cattlemen have come face to face with one of their costliest enemies. Wolves, coyotes, bobcats, or mountain lions have appeared and sheep and cattle are being slaughtered by the hundreds. Or grain fields are rapidly disappearing under the attacks of cutting, boring, or tunneling rodents.

The answer of the Government bureau comes quickly. On horseback or in light cars, hunters and trappers, long trained in their craft, are dispatched to the scene. Among them will be Government men and men employed by the state.

Costly? The loss to farmers by rodents alone totals many millions a year, while the annual board bill of the large predatory animals, paid by American stock raisers, is something like $13,000,000. The New England States report a loss of nearly $40.00 a farm each year due to rats. In many western states prairie dogs and ground squirrels cause a loss that may reach twenty-five percent of the total crop.

The expert sent to the scene must be detective, hunter, and trapper rolled into one. Not only must he determine what sort of animal is causing the trouble, but he must lay his plans and carry them out in a manner that will prevail against the wary, suspicious, cunning marauders. He must know the habits of every animal he sets out to exterminate.

According to Stanley P. Young, in charge of the Division of Predatory Animal and Rodent Control, who has his office at Washington, D. C., every marauder leaves a clue behind it.

"They are like criminals," he explained. "Each type kills in its own way."

If a sheep is found with its back broken by a mighty blow, the hunter knows a bear has turned outlaw and must be hunted down from among his better natured brothers. A cut throat points to coyote. A bobcat kills by gripping the back of its prey's neck with teeth and claws and crushing the base of the skull. Smashed shoulders with long, tearing claw marks are the work of the mountain lion.

In each case, the plot must be laid to catch the animal sought. A coyote or wolf will not walk blindly into a bear trap. The elaborate care needed to trap the coyote is unnecessary with the big cats.

When a sheep or calf is found dead, but untouched except for its broken back, the answer is bear. The hunters know that the bear, turned outlaw, will wait for his prey to cool before coming back to eat it. The trap is then set near the carcass and usually the bear is caught.

Much more subtle and elaborate means are needed to trap the coyote or wolf, most wary of all killers. The slightest strange sight, scent, or sound will reach his keen senses and drive him away. No matter how he is to be caught, extraordinary precautions must be observed.

If the coyote is to be trapped, the trap must be hidden along the path taken by the animals to water or feed. The trapper must wear gloves and stand on cloth while he is working so as not to leave any human scent. The trap must be camouflaged with some native growth and the camou-

SETTING A TRAP FOR A COYOTE

1 In setting a trap for coyotes or wolves the utmost care must be taken to see that no human scent is left. The trapper wears gloves, kneels on canvas, and uses a wooden paddle to drive stakes.

2 Here is the trap. When the pan in the center is touched, instantly the jaws shut.

3 Below, the trapper is covering a coyote trap with foliage to camouflage it. Site is then scented with an attractive odor.

4 After the coyote trap is set and scented and hidden beneath foliage, the trained trapper, who has stood on canvas, takes the greatest care to see that he leaves no sign of presence.

5 As the coyote approaches the bait he grows suspicious and moves away in a circle. Discovering no man-scent and attracted by the artificial odor and the smell of the fresh meat, the hidden trap grabs him.

Killer Beasts

Cost Farmers Millions a Year

flage scented with an odor attractive to its intended victim.

Often, coyote and wolves are found in packs so large that heroic methods must be taken to control them. It is then that the hunter must bring all of his training and experience to bear.

He knows that the coyote or wolf follows a certain path in moving from one point to another. He also knows that anything unusual in the path will cause the animal to leave it and travel in a circle to investigate. Armed with this knowledge, he proceeds to make arrangements looking to a speedy end to the stockman's troubles.

A leg of beef, mutton, or horse meat is placed in the path. Then, in a circle around it are placed several groups of fat. These groups usually consist of three pieces, the one in the center and nearest the path containing a large dose of strychnine. This poison is used because it is humane and may be handled with safety.

Coming down the path, the coyote or wolf sees the bait and starts to circle warily around it. He comes upon a piece of fat, sniffs it, and cautiously tastes it. Finding it good, he then turns to other hunks of fat until he reaches the one that has been poisoned.

In placing this bait, the trapper first covers his hands with the same fat he is using and stands on canvas while he works.

Often the hunter comes upon individual cases that must be handled in an original way. One of these was "Old Lefty of Burns Hole," a wolf that came into Young's experience while he was working in Colorado.

Lefty was a huge wolf that had lost its left paw in a trap. He always walked with his leg off the ground, and he had become so wary that trapping him seemed impossible. After months of patient watching, it was discovered that Lefty put his injured leg down when he crossed a high place in the path. That trait led to his capture.

The Government agents set a trap behind a high windfall on a path frequently traveled by Lefty. Before the day was gone he had been captured by the same foot that had once been mangled between the jaws of a trap.

Less spectacular but more important to the average person is the war against rodents. Rats, particularly, take an immense annual toll from every citizen, no matter what his business or position in life. It is estimated that there are as many rats in the United States as there are citizens, and that each rat causes a property loss of two dollars each year.

As everyone now knows, rats carry bubonic plague. It has lately been discovered that ground squirrels are carriers of spotted fever. Jack rabbits carry tularemia. In addition, these rodents cut down crops, burrow under planted fields, and tear out roots. Not even trees are spared by their sharp chisel-like teeth.

Rats, however, are the costliest and most dangerous.

Many means have been tried to combat these pests. Hydrocyanic acid gas has been used with little success, because the rat's nest is usually so porous that the gas escapes. Poisons are dangerous because of the proximity of domestic animals. The powder of a Mediterranean bulb, red squill, has been found effective against rats and harmless to other animals, but its concentration in the finished poison is uncertain.

MOST OF OUR New Steel *Comes from* JUNK PILE

At left, a huge magnet loads scrap iron into a railway car. Above, after the war many sea fighters were junked. Here the big guns are being cut to pieces with help of acetylene torch.

NEW railroads for old, skyscrapers and bridges from obsolete battleships, 1932 sport cars from automobile graveyards! This is not a prophesy, but a cold statement of a routine miracle of the steel age in which we live.

At the rate of several million tons a month, outworn, mangled, discarded articles of iron and steel, from borings and tin cans to ships and locomotives, are collected, prepared, and finally transformed into brand-new articles of steel.

More than 39,000,000 gross tons of such scrap went into the making of the 56,000,000 tons of steel produced in this country in 1929. This "worthless" material was eagerly bought by the mills and foundries for half a billion dollars. Used alone, it would have produced enough steel to have built the skeletons of a thousand fifty-story skyscrapers.

Material for the scrap iron and steel dealer often comes from extraordinary sources. Not long ago a railroad offered for sale about sixty old locomotives. To the average layman, sixty old locomotives might represent a questionable bargain. To a certain scrap dealer, however, they were a prize. He bought the entire lot. From past experience he knew that he could make the herd of iron monsters pay him money.

Many of the locomotives were in first-class working condition. Some of these, the dealer found, he could sell outright to manufacturing plants for hauling cars about their yards; some to smaller railroads, for service that did not require the most modern equipment. Two he sold to a motion picture producer for a scene that required a sensational wreck. After the wreck, his men salvaged the pieces.

The remainder were destined for the furnace. A crew of experts, equipped with cranes, pneumatic chisels, and acetylene torches, were sent down to "location." Gages and other measuring instruments, copper and brass, all parts that might be resold as secondhand material were first stripped from the locomotives. Then the torch-men and chisel-men cut the engines apart, piece by piece, into such sizes and shapes as would be acceptable at a mill.

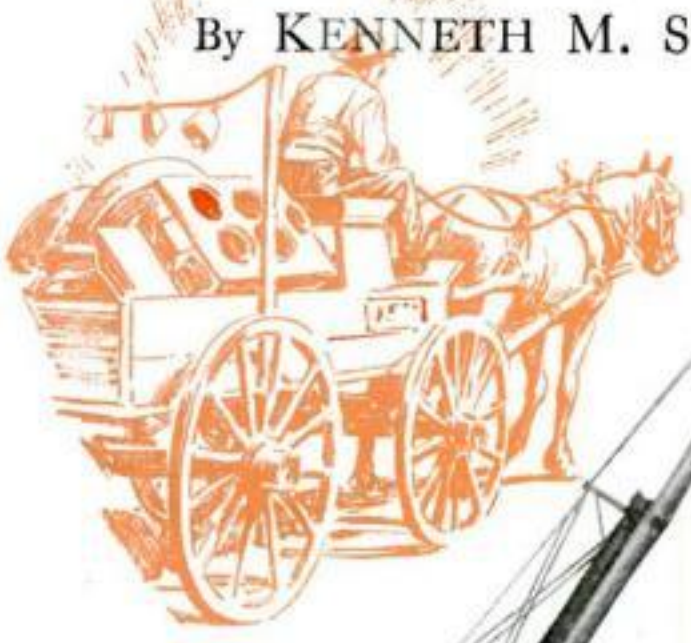
Boiler plate, knuckles, couplers, springs, grate bars, axles, wrought iron parts, wheels, tires, were separated. Iron and steel of different size, quality, amount of phosphorus, manganese, and so forth, would be used differently and bring different prices. The whole tonnage of this scrap was finally shipped to mills that had contracted for it, to be remelted and transfomed into rails, girders, automobile parts, or maybe new locomotives!

Locomotives are just one item that figure in the daily business of a big scrap dealer. Sometimes he buys a whole railroad, and then has all the rails and cars to scrap. A New Jersey dealer recently contracted to scrap nearly 300 obsolete street cars. Since the war, battleships have been great prizes for the scrap man. After the Naval Treaty of 1922, one dealer in Philadelphia had a

Most of the scrap metal is collected by junkmen, but some of it comes in carts drawn by boys who thus earn pocket money.

Read the Remarkable Story of How 39,000,000 Tons of Scrap Are Saved in America Each Year

By KENNETH M. SWEZEY



Recovering metal in old autos is developing into a big business. Plans call for scrapping of 3,000,000 cars a year. At top, molds being filled with molten metal.

Light scrap in this form is worthless. Before the mills can handle it, a big hydraulic press forces it into 600-pound bales.

tonnage of battleships tied up in his water-front yard equal to the combined navies of Italy, France, and Japan!

The Institute of Scrap Iron and Steel, an organization that represents almost the entire scrap iron dealer tonnage in this country, is now working on a plan to scrap nearly 3,000,000 old automobiles each year. With this plan in operation the roads will be cleared of the "junk-car" menace, an increased market for new cars will be created, and more than a million tons of metal that otherwise might have rusted out in roadside graveyards will be turned into new steel.

This industry, which has grown to such size and efficiency that it saves the United States nearly 150,000,000 tons of natural resources yearly, is a child of the World War. Previous to 1916, steel had been made almost entirely from new material, pig iron; which had in turn been made by smelting iron ore with coke and limestone. Five tons of these raw materials were needed to produce every ton of steel. The process took time. Demands for shells, guns, machines, ever more urgent, made it absolutely necessary to find a quicker method of production.

It was natural to turn to the scrap heap. Electric furnaces could make fine steel from a diet of as much as 100 percent scrap; while open-hearth furnaces, which were at the time producing most of the world's steel, could utilize a mixture made up of from fifty to sixty-five percent scrap and the balance pig iron.

The real question, however, that confounded the steel makers was: "Where can we *get* the scrap?" They were sure that more than a hundred million tons of iron and steel in various forms were lying about doing nobody any good.

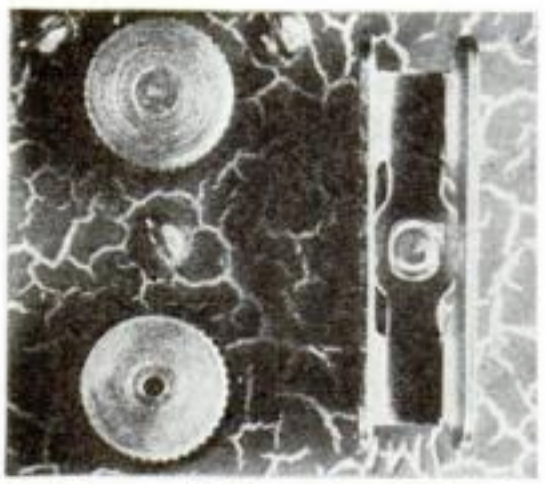
But how could this waste be procured? How could it be made suitable for the furnace? Someone had to gather the scrap, tear down and transport the steel of bridges, rip up rails, and get them to the mills. The various forms of iron and steel had to be sorted; heavy pieces of metal were used one way, light pieces another, alloy steels could be used only under certain conditions, some forms of steel could not be used at all until they had received proper preparation.

It was because of these reasons that extensive use of scrap had not been made before. Pre-war demands had never raised the premium for scrap high enough to become an incentive for its large scale collection and preparation. The scrap that had been collected was chiefly the result of the efforts of the little junkman, who went from house to house with his cart and bells, and a few larger dealers with yards filled with iron and steel wrack of every description, hoping and waiting for an

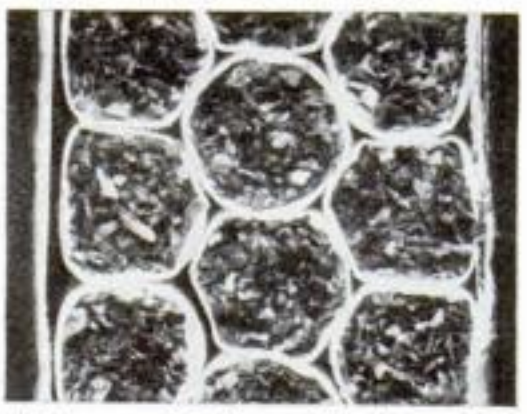
(Continued on page 120)

Can the Camera *Fool Your* Eye?

Close-up Photos Alter Appearance of Familiar Things



2 You certainly know what this is and how you have hated it at times! The world is full of people who consider it the greatest nuisance known to mankind.



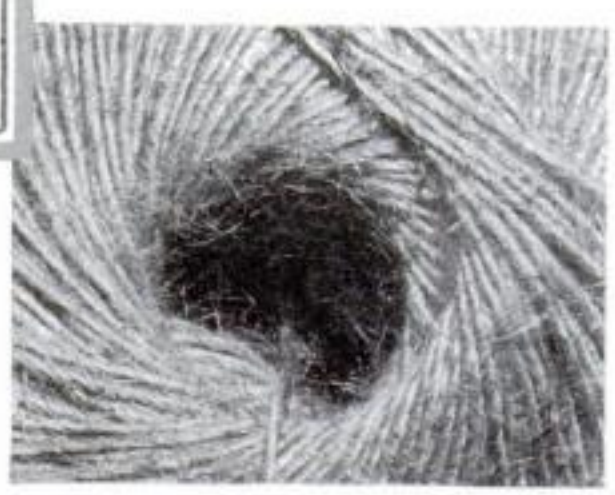
1 Take a good look at this picture. Do you know what these queer things are? Just to help you and get you started right in solving the picture puzzles on this page we will tell you they are cigarettes. Now look at the other pictures, read the captions, and see if you can tell what they are without looking at the answers.

See Page 120 for Answers

9 This is not a plate. It is not a dish of any kind and it has no relation to the famous Wedgewood ware. It's a handy gadget that serves a useful purpose.

3 This may look like one of the tight-fitting hats girls are wearing nowadays, but it isn't. Take a good look at it. This one is easy to guess and should help raise your average.

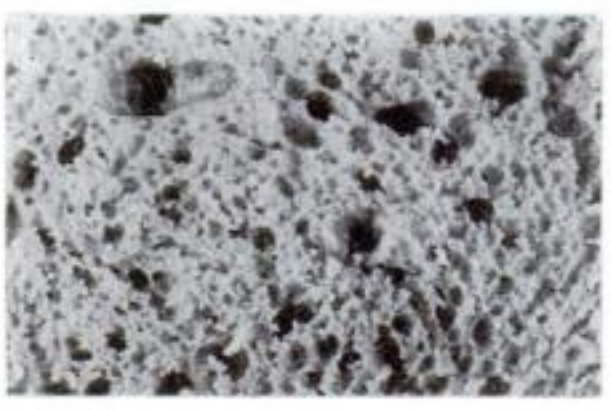
6 This you may think is some kind of moss or the tiny roots of a grass plant. If that's your idea you're wrong. And it isn't a new breakfast food either. You know it well and use it a lot.



10 You will have no trouble with this one, which is so simple every one will recognize it at a glance. It isn't a nest of any kind but it is something that you use fairly often.

4 You are wrong. These are not tumbling waves and neither are they clothes in a washing machine. It is something you should eat because it contains quantities of Vitamin D.

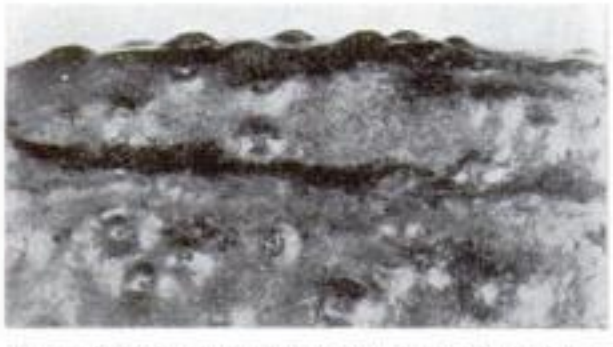
7 This is not a view of distant hills nor are the streamers clouds or parts of a smoke screen. They are not ropes and they're not streaks of sand. Do you know what they are?



11 Does this look like some kind of rock or is it a picture of the bathroom sponge? It isn't either of those, but is something you'd have great difficulty in getting along without.

5 You think this is some kind of automobile tire with two different sized treads? It may look like it but that's not what it is. After all, it's an easy one to guess if you'll just stop and take a good hard look at it. We'll tell you this much: you'll find it in almost every household.

8 Here are old friends of yours, and what a fuss you make when you can't find one. Most men carry them in their pockets constantly and in the course of a year use a good many of them, but seen in this unusual view do you recognize them at once? Take another look.



12 This is something you eat, at least many people eat it and like it. It doesn't come out of the sea so of course it's no kind of fish, and the things that look like eyes just look that way but aren't. With all of this help you should have no trouble naming it, so exactly what is it?

Police Dogs *Guard German Railroads*

TRAINED dogs now help German as well as American railway policemen hunt for criminals and car thieves (P.S.M., July '31, p. 13). The Germans, with typical thoroughness, have established training schools for police dogs.

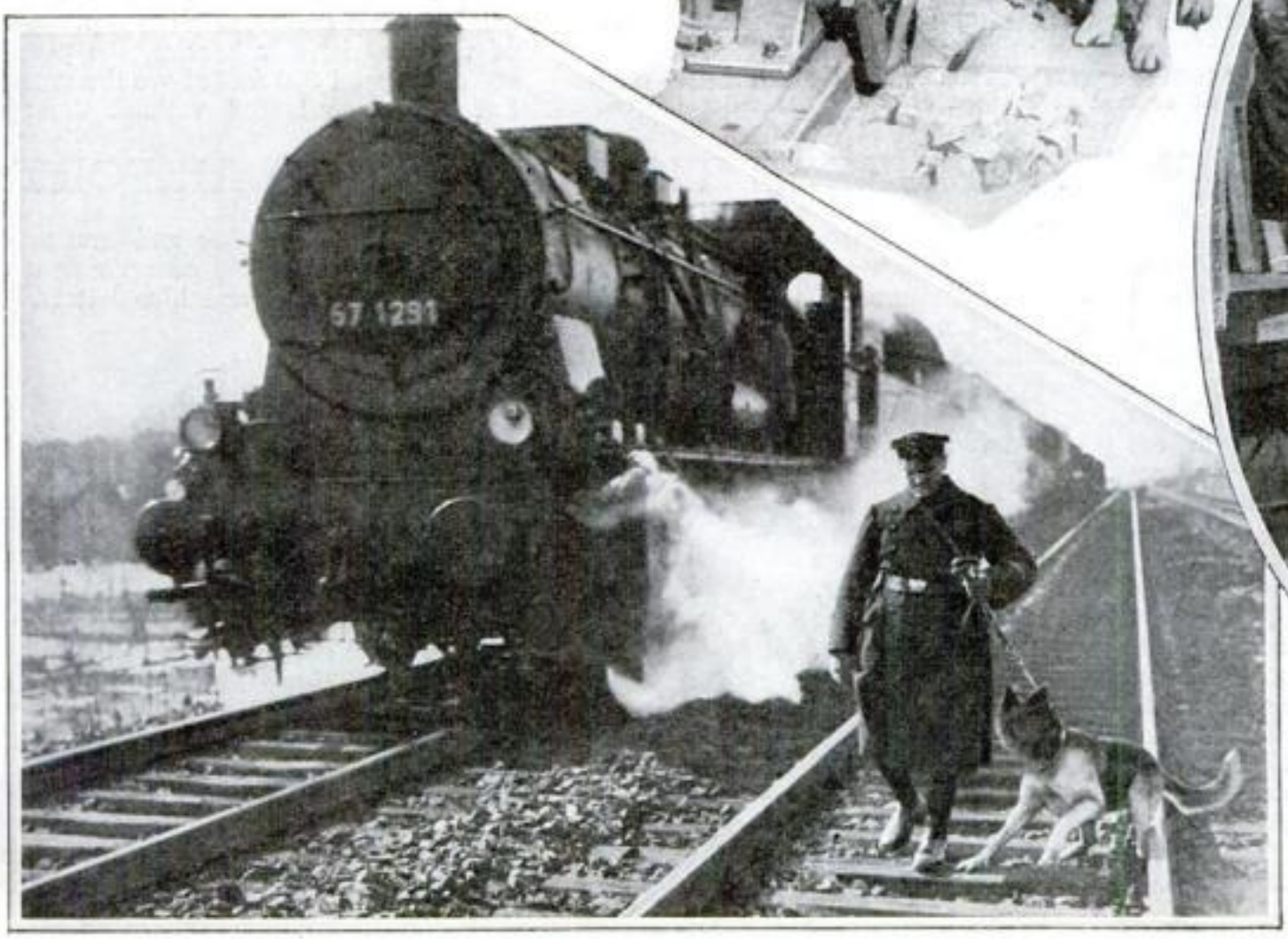
After months of hard schooling, the Alsatian dogs are ready to go through the performances shown on this page. They are taken to some out-of-the-way spot along the line, where an official unknown to the dogs assumes the role of thief. Often unusual agility is required of him to escape the dogs' snapping teeth. The chase does not end for the animal until the fugitive is "treed" on a telegraph pole or is plainly captured by his human pursuer. Should he show fight, the dog is ready to leap at him again. Thus pilferers of wire or track equipment and thieves who steal from freight cars are apprehended.

Besides going with a railroad policeman on his round, the dogs have another duty. One of them travels as a special guest on each train laden with valuables.

Lying at attention, this police dog watches carefully while his master, a German railway detective, searches a suspect. At a suspicious movement, the dog would leap upon the prisoner.

While valuable packages of money or jewels are in transit, a watchful police dog stands guard ready to hurl himself upon an intruder.

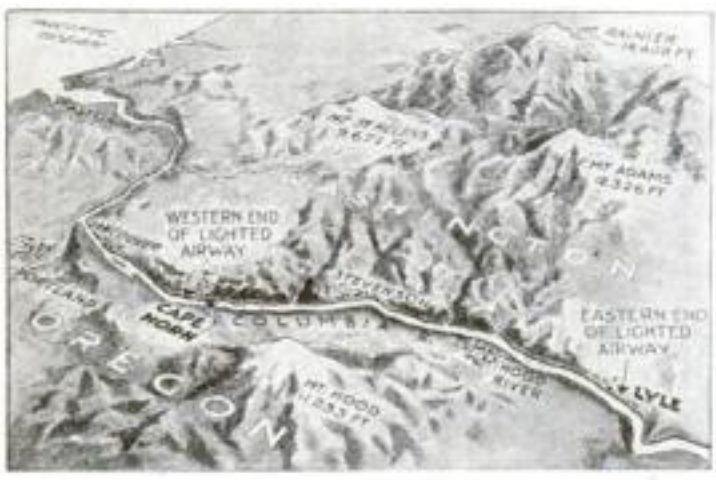
At right, a police dog is an interested spectator while railroad signal apparatus is searched for weapons that may have been hidden by freight car robbers.



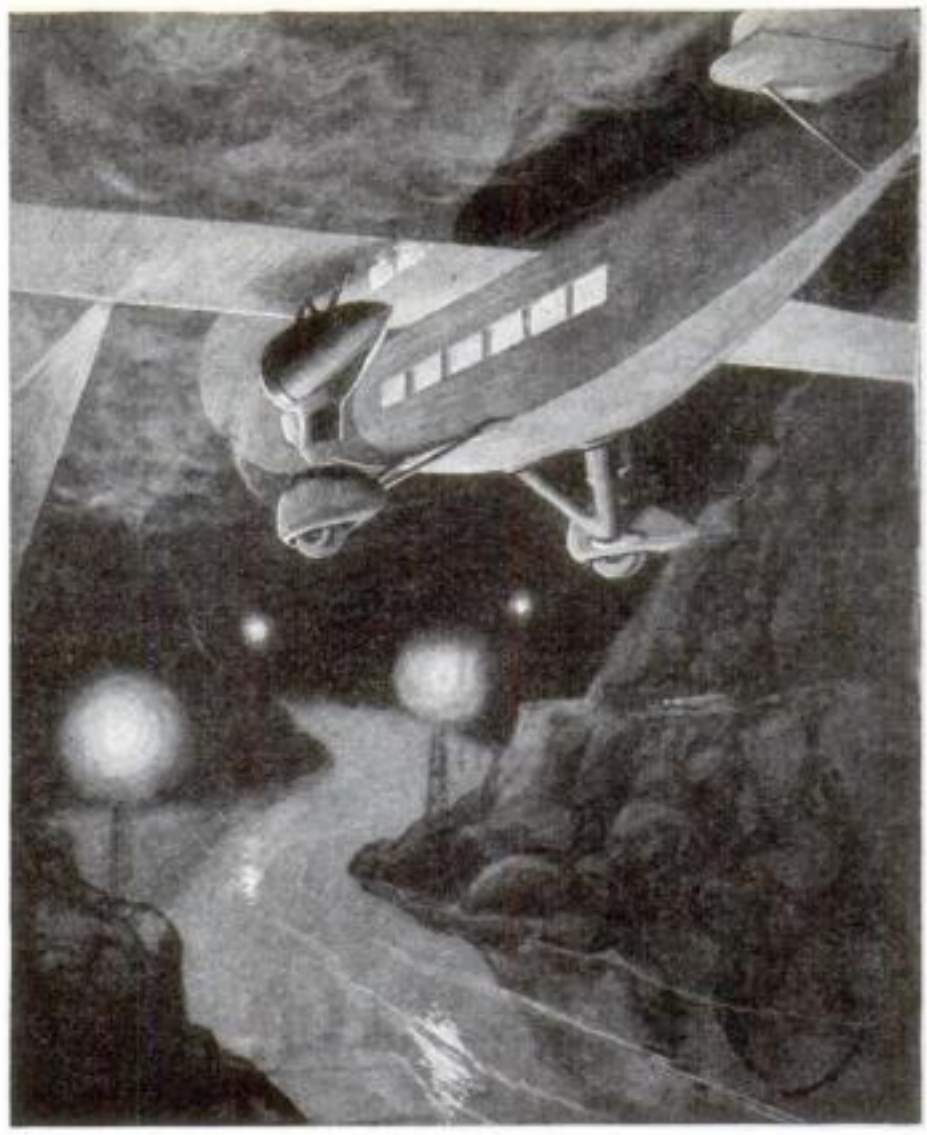
In training these dogs a fake thief tries to hide. Above, at the first effort this dog found the robber hiding in a coal truck. He will hold him there until the detectives arrive. At left, a railway policeman walks the track with his dog to inure him to the noise of an engine.

FIFTY-MILE MOUNTAIN GORGE NOW LIGHTED FOR FLYERS

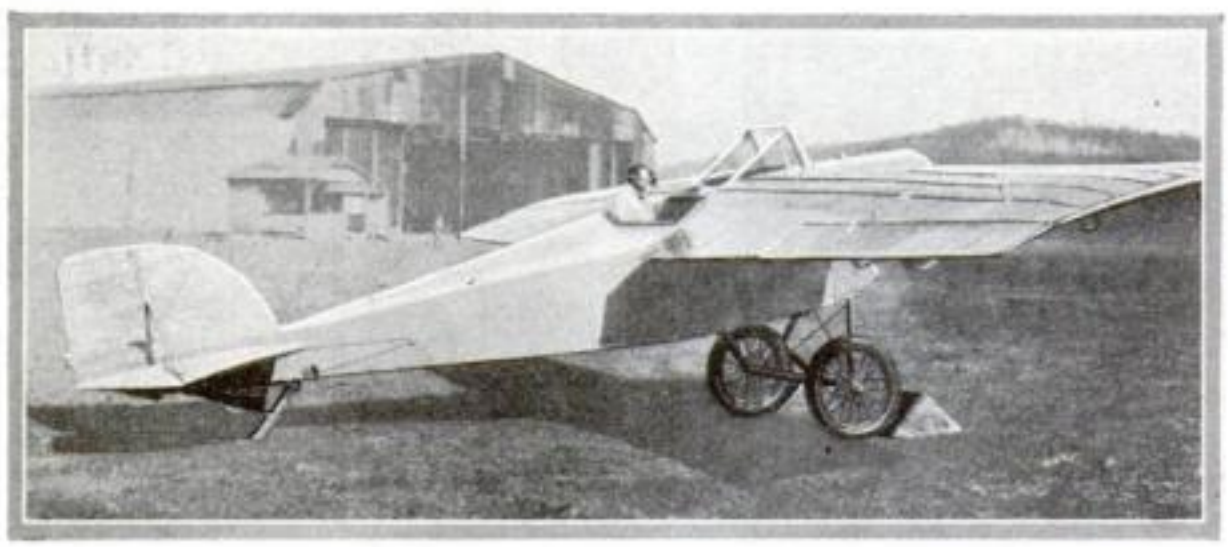
NIGHT pilots flying between Portland, Ore., and Pasco, Wash., now pass through a lighted "tunnel" fifty miles long. Because of the danger of running into neighboring mountains in a fog, they follow the course of the Columbia River. The high walls of the river gorge form the sides of the tunnel, and low-hanging fog often completes it with a roof. On the fifty-mile stretch between Cape Horn, Wash., and Lyle, Wash., special lights have now been installed. Green beacons flash along the Washington side of the gorge, and red lights line the Oregon side. The aviator skimming along under the 250-foot "ceiling" steers between the rows of lights which are made necessary by the fact that the heavy fog entirely blots out the regular revolving beacons. Winds keep the bottom of the gorge free of fog.



At left, map shows location of fifty-mile tunnel in Washington lighted for night flyers.



Beneath a 250-foot ceiling of fog, night pilots are guided between rows of red and green lights along Columbia River.



An Austrian mechanic designed and built this plane which is equipped with Venetian blind wings, said to enable it to take off or land at a speed of twenty-five miles or less.

VENETIAN BLIND WINGS TRIED ON NEW PLANE

IMITATING the loosely feathered wings of an eagle, an Austrian mechanic, Julius Franz Ziegler, has just built an airplane with wings like a Venetian blind. Built up of slats fastened together elastically, which are designed to adjust themselves automatically to air currents, they curve downward and to the rear in the shape of a letter "C." The plane is said to take off at twenty-five miles an hour and land at even slower speed. During a test flight under the supervision of the Austrian Air Service, the plane's engine stopped 300 feet above the ground but the plane landed without damage.

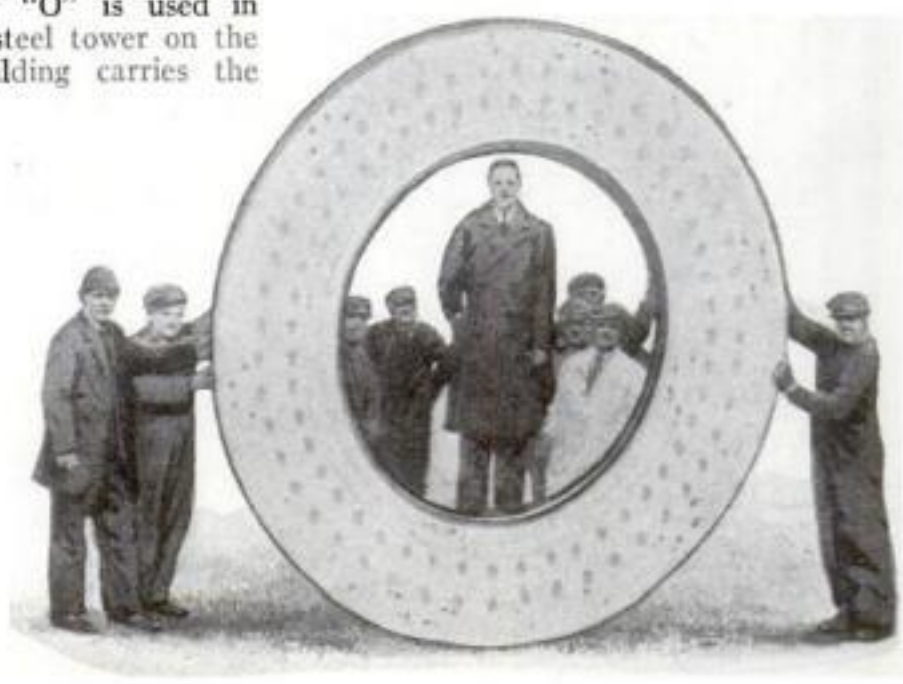
JAPANESE BOY STARTS MEMORIAL FOR FLYER

A FEW months ago, Lieut. William Caldwell, U. S. Army flyer, crashed and was killed. He was accompanying another plane speeding Japan's ratification of the London naval treaty eastward across the United States. When news of this tragedy flashed over the cables to Japan, it was heard with especial sadness by Shigeyoshi Fukushima, sixth grade Japanese schoolboy. He opened his bank and took out seventy yen, thirty-five cents in American money. This he sent to the American Embassy in Tokyo with a suggestion that it be made the nucleus of a fund for a memorial to the flyer. Diplomatic wheels began to grind. Secretary of State Stimson conferred with officials of the War Department. Now it is announced that a bronze wreath will be designed and placed on Caldwell's grave. The design will also provide space to record the tale of Shigeyoshi and his seventy yen.

HUGE NEON TUBE POINTS TO AIRPORT

THE picture at lower right shows workmen erecting a combined air beacon and advertising sign at Indianapolis, Ind. The eight-by-ten-foot letter "O" is used in the ad. A four-sided steel tower on the roof of an office building carries the aerial beacon, said to be the largest in the world. The four advertising signs are on its sides. The air beacon is a huge neon tube arrow, said to be visible for seventy-five miles, pointing toward the municipal airport of Indianapolis. More than half a mile of neon tubing and five miles of electric wiring are being used in the construction of the letters and beacon.

Double rows of tubing and groups of electric bulbs cause the advertisement to flash in red, white, and blue letters.



Plane Catapulted into Air by Powerful Merry-Go-Round

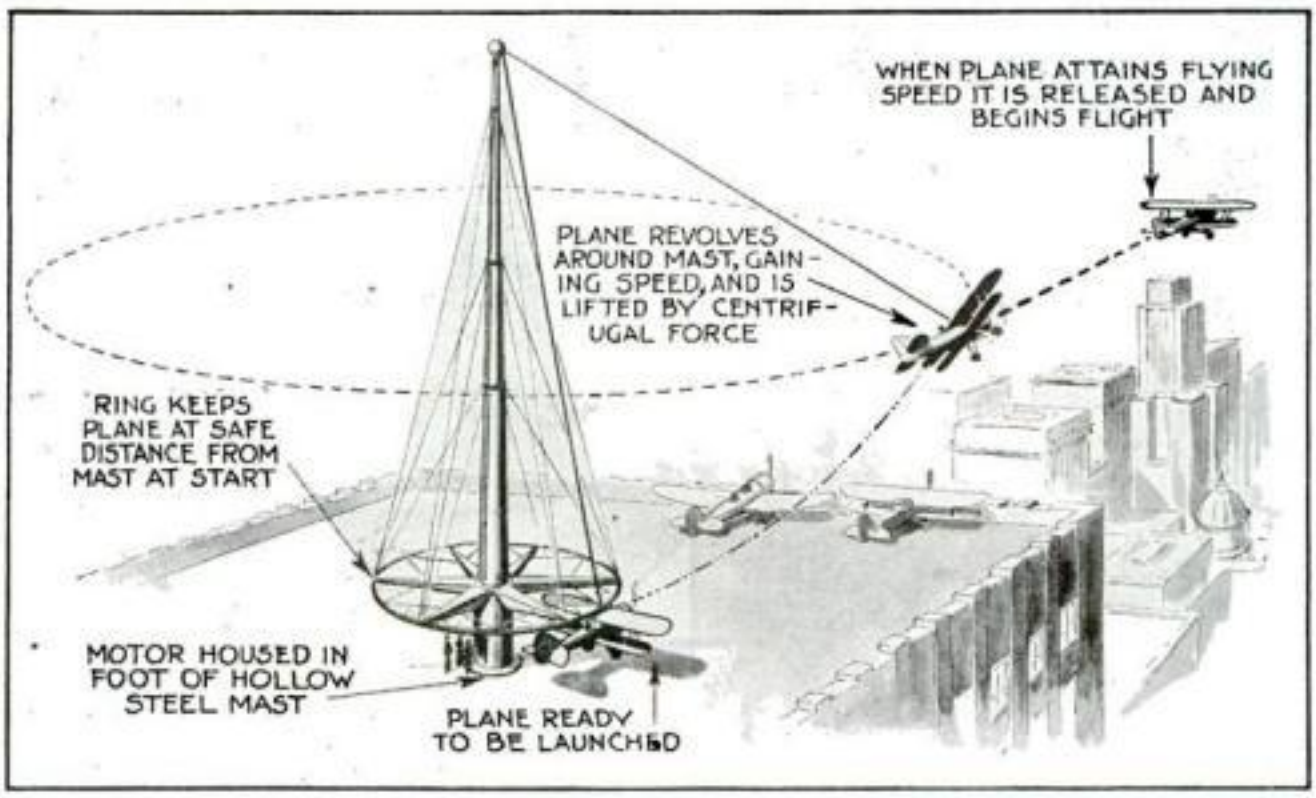


Diagram showing how an airplane is whirled at the end of a revolving lever and automatically launched when flying speed has been attained.

As BOYS throw stones from slingshots whirled around their heads, so a rotating catapult just patented will enable aircraft to take off from restricted areas, like the roofs of buildings. To a vertical pole that rotates at high speed is attached a long lever. This is pivoted to the pole at its top, while a plane is fixed to its lower end by an automatic releasing gear. Then the pole is set in motion. As the speed increases the plane rises on the end of the long lever, swung out from the pole by centrifugal force. It is then going around and around like cars of "flying swings." As the speed of the launching device approximates the plane's flying speed, it is automatically released and the plane is flung into the air. The inventor says planes can be landed by a reversal of this method. The diagram at the left makes the launching process clear.

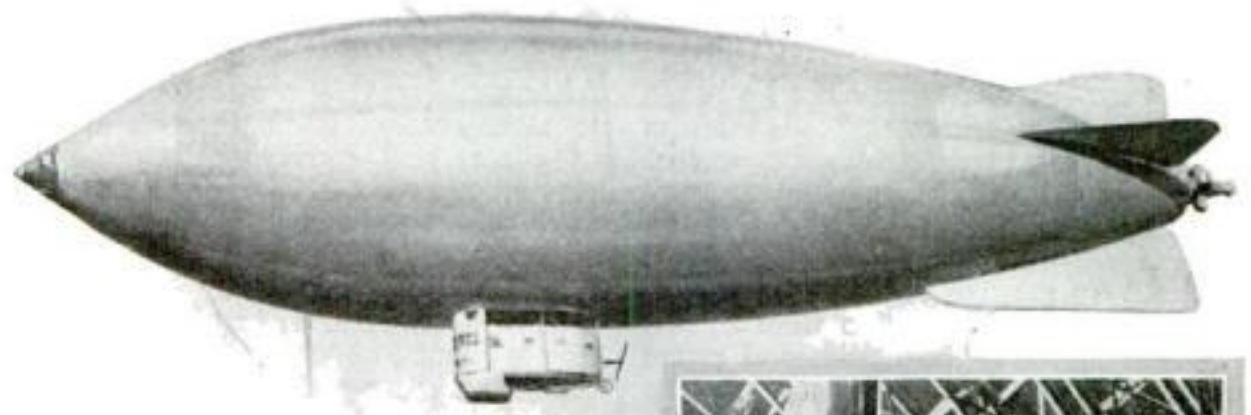
U. S. COMMERCE PLANES GET NEW COLOR SCHEME

A NEW color scheme for the U. S. Department of Commerce planes paints the top of the wings "international orange." Wheel fairings and front cowlings are maroon. Fuselages, and bottom wings of biplanes, are painted aluminum, and landing gear is black.

USE FAN-SHAPED BEACON TO GUIDE AVIATORS

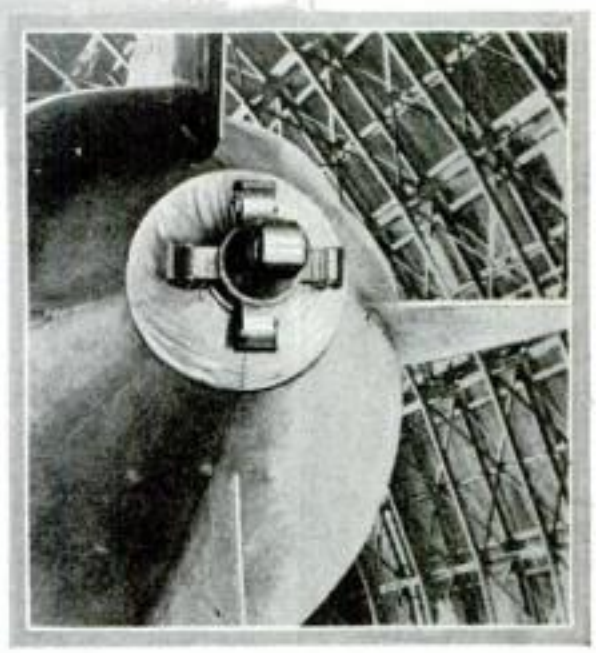
SO THAT aviators will have no difficulty in distinguishing an airway beacon from a city's lights, a new beacon has been invented that projects a fan-shaped sheaf of six rays into the sky. The beacon was successfully tested recently by the U. S. Army Air Corps.

Fan-shaped beacon, of six directed rays, may be used to identify airway from city lights.



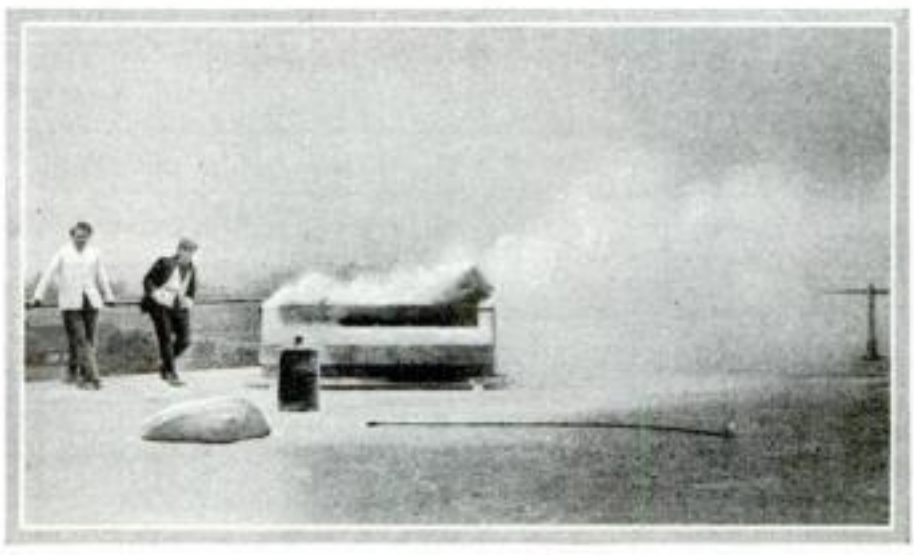
COMPRESSED AIR JETS LAND NEW DIRIGIBLE

JETS of compressed air enable a remarkable 180-foot airship recently tried out near Milan, Italy, to land without a ground crew. The nose of the ship contains five valves, through which a centrifugal pump spurts air in any direction. There is a similar set of valves in the tail. By opening valves, the pilot can maneuver his craft up, down, or sideways through the reaction from the compressed air jets. In ordinary flight the craft is driven by a conventional propeller.



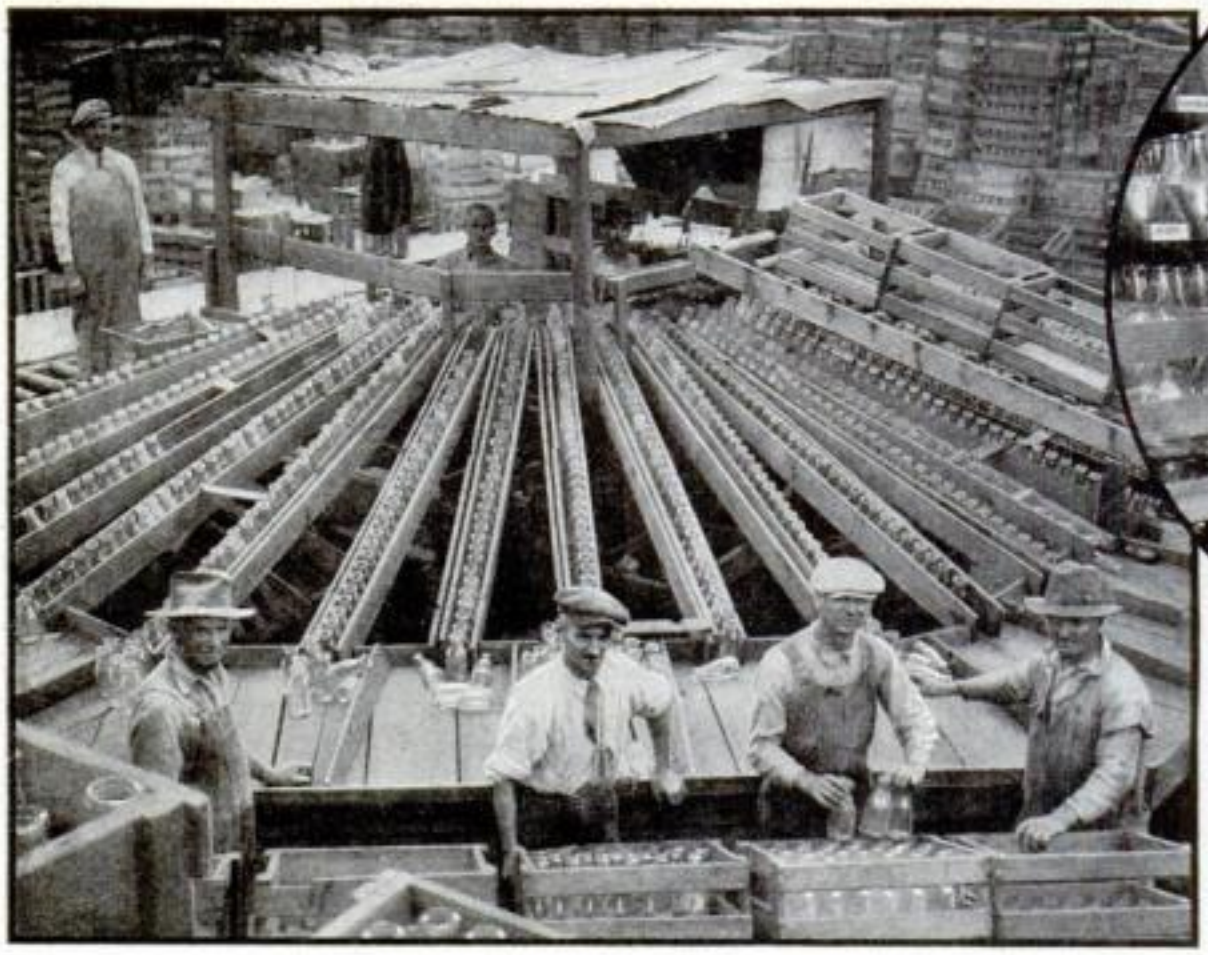
Top, dirigible that lands by jets of compressed air. Above, close-up of the valves.

SOLDIERS HIDDEN BY ARTIFICIAL FOG



FRENCH army engineers have created a fog that may replace the camouflage used during the World War. The chemical fog, formed of lime and sulphur compounds, covers large areas. During recent experiments in France a region many miles in extent was covered, effectively concealing troops from airplane observers.

Lost Milk Bottles Found for Dairies



Above, milk bottles, stolen or lost, being sorted at Los Angeles' bottle exchange. Left, system of conveyors by which clean bottles are assembled.

No VAST sums of money change hands over its counters nor do high-speed tickers record its many transactions, but one of the busiest and oddest of Los Angeles' commercial enterprises is its "Milk Bottle Exchange." Here lost milk bottles, returned by mistake to the wrong dairy, are started on the way to their owner. "Detectives" visit the dairies and round up all strayed or stolen bottles. The exchange then collects them by truck. After washing, they are sorted according to their lettered labels through a series of chutes and conveyors. Crated and cleaned, they are sold back to the dairy at two cents a bottle. New bottles would cost the owner five cents apiece. Thus it is estimated that the Milk Bottle Exchange saves Los Angeles milk producers about $1,500 a day. An elaborate conveying system, as shown above, has been developed to handle the bottles.

ESCALATORS TO SERVE OFFICE BUILDINGS

ESCALATORS, used to handle crowds in department stores and railway stations, will be installed in two large New York office buildings to be opened next year. In one the moving stairs will serve the three basement floors devoted to employees' lunch rooms. A sixty-seven-story tower now being built will be fitted with escalators for the first six floors. During the morning these escalators will run upward and during the evening rush they will run down.

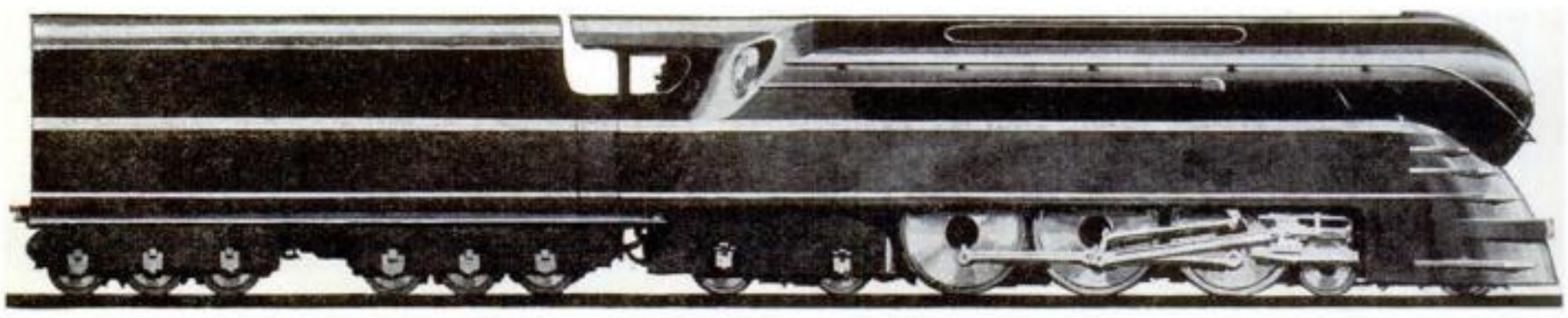
GLASS FULL OF WATER HOLDS 1,320 PINS

How many pins can you drop into a level glassful of water without making it overflow? When a Bournemouth, England, experimenter tried it the other day, the result surprised him. It took 1,320 pins to send the first drop of water trickling down the side. They weighed four ounces. The picture shows more than 1,000 pins in the glass.

NEW LOCOMOTIVE HIGHLY STREAMLINED

WHAT will railway trains of the future look like? According to O. Kuhler, New York City design engineer, who had practical experience in handling the movement of German rolling stock during the war, they will be streamlined to the utmost degree in order to reduce wind resistance at high speeds. Recently he worked out and patented a streamlining design for a New York Central locomotive of the "Hudson" type. The smokestack is sunk flush with the top, driving wheels are solid disks of stainless steel, and fairing makes one streamlined piece out of locomotive and tender. Now Kuhler is working out the details of streamlined cars to go with the engine. With coaches and engine built to reduce air resistance it is confidently predicted that higher speeds will be possible in the future.

At right, a recently built locomotive now in use on the New York Central lines and below proposed method of streamlining it to give greater speed.



DOUBLE ARROW ADDS TO BOW'S ACCURACY

A NEW style of arrow that is literally two, one inclosed within the other, has given greater accuracy and range to the bow and arrow. Its hexagonal shaft is built of strips of bamboo, glued around a balsa wood core. The balsa gives lightness and the bamboo strength. A cross section of the arrow is shown in insert.

USE OLD CAR TO ROLL TENNIS COURTS

A JUNKYARD automobile is doing the work of five men in rolling tennis courts at a Lincoln, Nebr., country club. The chassis of the resurrected car is mounted at the rear on a half-ton chain-driven roller. Wide-tread wheels are used in front. The builder reports that the 2,500-pound machine will travel from two to twenty miles an hour and will roll seven tennis courts in fifteen minutes. In a short time it more than paid for itself.

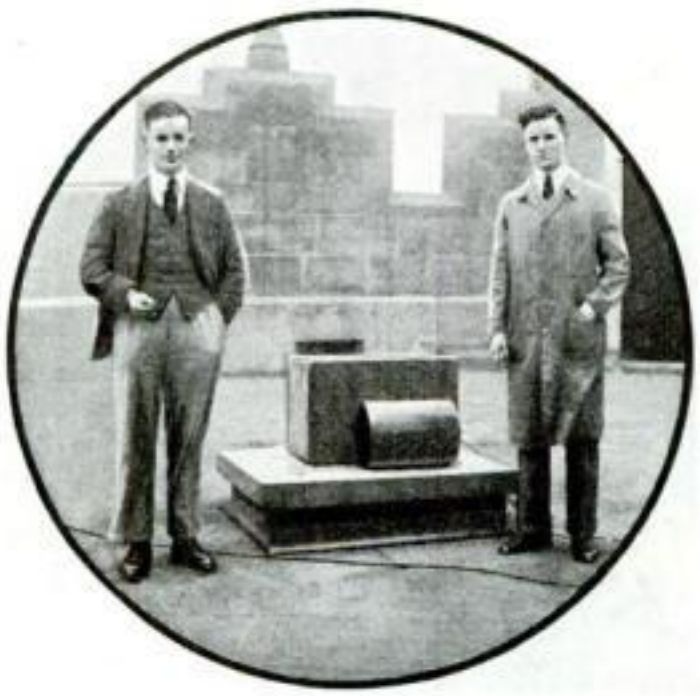
Discarded auto parts form most of this tennis court roller.

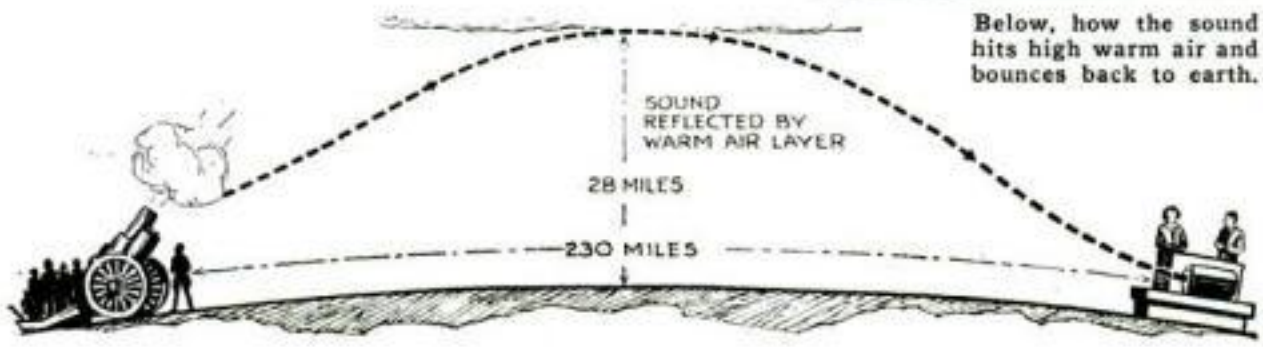
SUGAR PRODUCTS MADE INTO HOST OF THINGS

ORDINARY sugar is turned into a plastic substance by a newly developed process, about to be introduced commercially. The resulting product can be made into a bewildering number of articles, from artificial leather to combs, buttons, and electric insulators. According to an official of the concern holding the patents, the woman of the future may be clothed from head to foot in spun sugar. She can wear shoes of sugar leather, with heels of "sugar plastic," another form of the product, write with a sugar pen from a sugar-mounted bag that contains an unbreakable sugar mirror, seat herself in a chair made of sugar plastic, and watch her favorite movie star projected onto the screen by a sugar lens through a photographic film also made from sugar.

WARM AIR, HIGH UP, REFLECTS SOUND

WHY sounds like gunfire can be heard plainly many miles away, yet are inaudible to listeners at much nearer points, seems a mystery well on its way to solution. Not long ago Dr. F. J. W. Whipple, superintendent of the Kew Observatory in England, played the part of a detective to find out what happened to the sound waves between the time of their birth and their reappearance miles away, after having skipped a "zone of silence." His clue was the speed of sound. During British artillery practice at Yantlet, he arranged to have radio signals broadcast at the moment each gun was fired. At Birmingham, 230 miles away, and at other points he set up super-sensitive microphones to catch the inaudible sound of the gun. Then he timed the arrival of the sound wave, checking it against the practically instantaneous receipt of the radio signal. He found the length of time that the sound took to arrive could only be accounted for by assuming that it soared into the sky to a height of about thirty miles, and then descended to reach the Birmingham microphone—jumping over points in between. It comes back to earth, Dr. Whipple suggests, because it is reflected as by a mirror from a warm air layer high in the earth's atmosphere. The tests indicated that this layer must be as warm as 106° F., disagreeing with previous theories that the atmosphere's upper stories are intensely cold. The photograph below shows one of the super-sensitive microphones that was employed in the experiment, inclosed in a protecting canister.





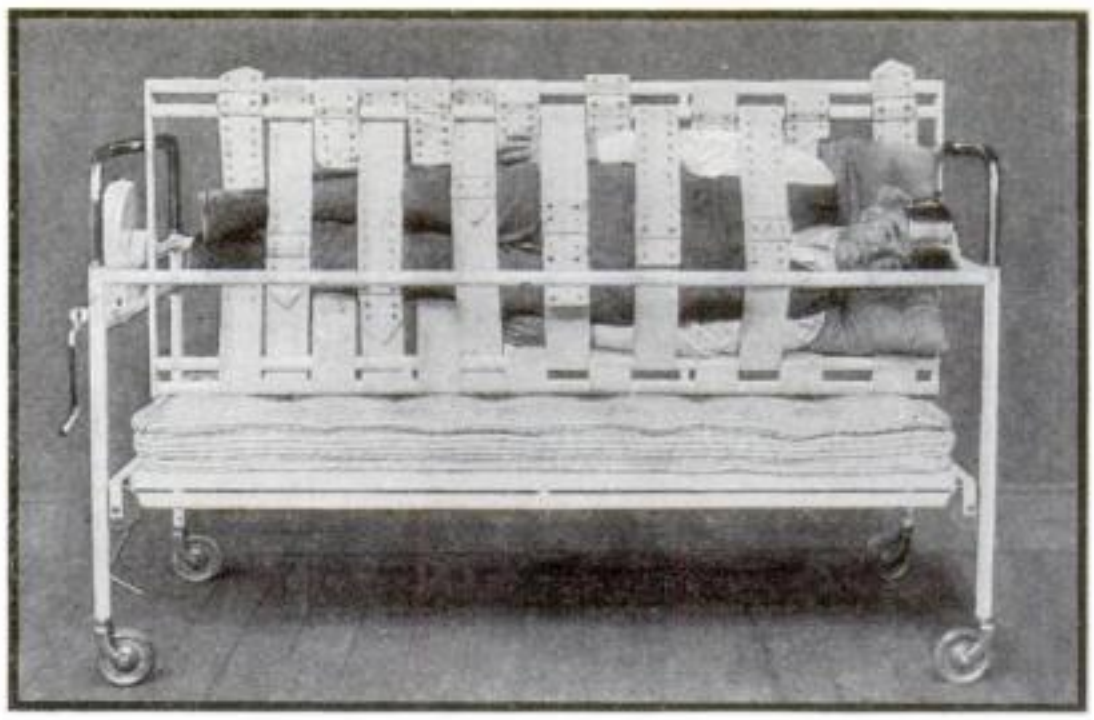
Below, how the sound hits high warm air and bounces back to earth.

TINY MOTOR DRIVES NEW LAWN EDGER

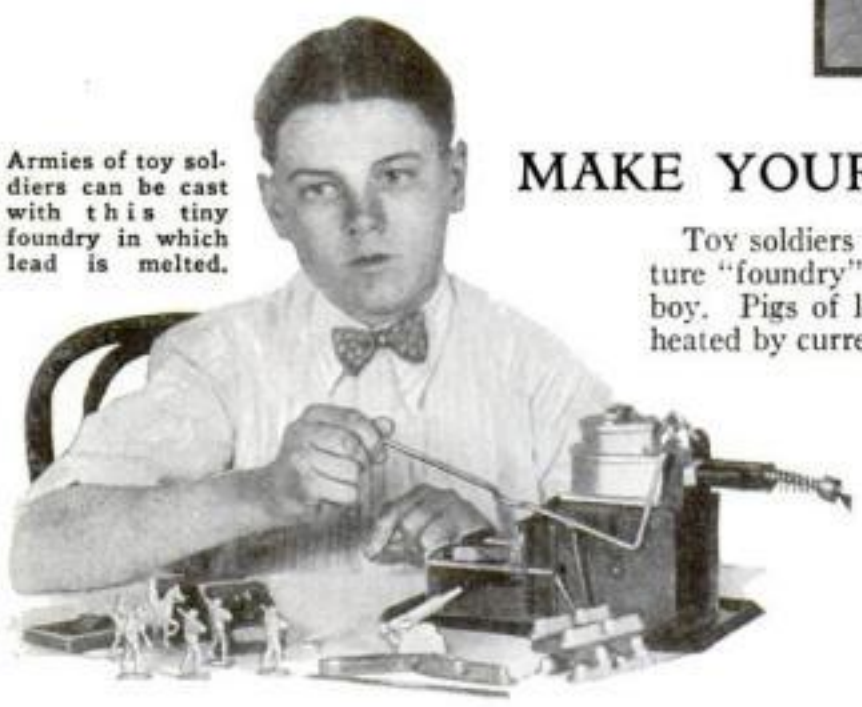
A MINIATURE hand-held mowing machine, run by a one-eighth-horsepower motor, is designed to make edging lawns and trimming around shrubbery a simple matter. The new garden accessory can be plugged into any lighting circuit by means of an extension cord. It is strong enough to trim hedges as well as grass, according to the maker, and it gives a smoother and more even job than when edges are trimmed by the laborious hand shears method, especially if the shears are not used by an expert.

NEW HOSPITAL BED WILL FLIP PATIENTS OVER

PATIENTS are flipped over like flapjacks on a griddle by means of a hospital bed designed by a Canadian inventor. The bed is expected to facilitate examination of an emergency patient as soon as he is received, before the extent of his injuries is known. He is strapped into a fabric-covered framework directly over the mattress. If it becomes necessary to turn him over, the mattress is dropped and the framework is rotated. It can be moved through a complete circle, and held by clamps at any point in its rotation while the patient is being examined. A helmet keeps the patient's head from sagging. According to the inventor, the new bed does the work usually performed by several nurses.



Hospital patient strapped in fabric-covered framework of bed is revolved.



Armies of toy soldiers can be cast with this tiny foundry in which lead is melted.

MAKE YOUR OWN SOLDIERS

Toy soldiers of lead are cast in a miniature "foundry" that can be operated by a boy. Pigs of lead, melted in a small pot heated by current from an ordinary household electric circuit, are run into molds. When the casting is taken from the mold it is a complete soldier when sharp edges are removed with a file. Molds for different kinds of soldiers give the young general a chance to cast opposing armies for a "war."

VACUUM CLEANER RIDS LAND OF STUMPS

ORDINARY vacuum cleaners are being used to clear land of tree stumps. The new method was developed by experts of the State College of Washington. The cleaner is used to supply forced draft in burning the stump. With dust bag removed, a distributor is substituted, to which lengths of air hose are attached. Joined at their nozzles by gas pipes from the nearest supply, they form veritable blowtorches. Meanwhile the stump is bored with several horizontal auger holes eight to thirty inches from the roots, and a fire started with kindling and oil. The blowtorches finish the job quickly, an average stump taking only ten hours to burn instead of several days as by other methods. Tests in western Washington have convinced experts and practical farmers that the method is efficient.

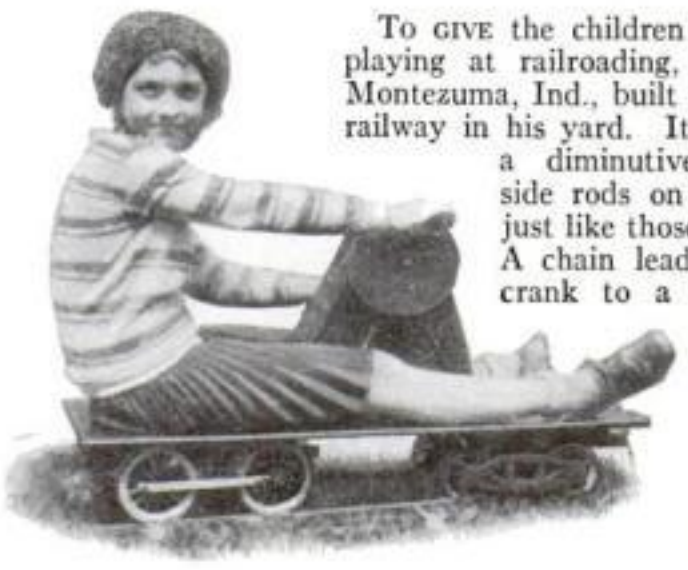
An ordinary vacuum cleaner, with distributor and hose lengths attached, is used as a blowtorch in burning out old tree stumps.

STILTS CAN BE CHANGED TO FIT THREE SIZES

ADJUSTABLE walking stilts now provide fun for youngsters of all sizes. Their steel steps, held firmly in a groove by a wing bolt, may be adjusted to three heights. Should the stilts be used indoors, there is no danger of slipping or marring polished floors because live rubber feet make them noiseless and skidproof.

TOY HANDCAR ON RAILS

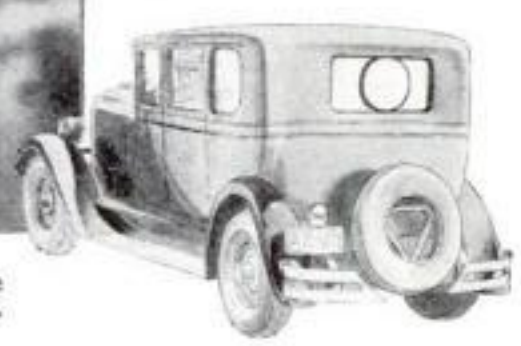
All the thrills of real railroading are provided by this diminutive handcar which has side rods on its drive wheels and which runs on a steel track.



TO GIVE the children all the thrills of playing at railroading, W. F. Blue, of Montezuma, Ind., built a novel miniature railway in his yard. Its "locomotive" is a diminutive handcar, with side rods on the drive wheels just like those on a real engine. A chain leads from the hand crank to a sprocket on the front axle. The handcar rolls on flanged wheels along a track of steel rails laid on oak ties. It can go forward or backward.

LENS HELPS CAR DRIVER'S REAR VIEW

Looking into the driver's mirror. Note reflected outline of lens and how the rear view is enlarged and clear-cut.

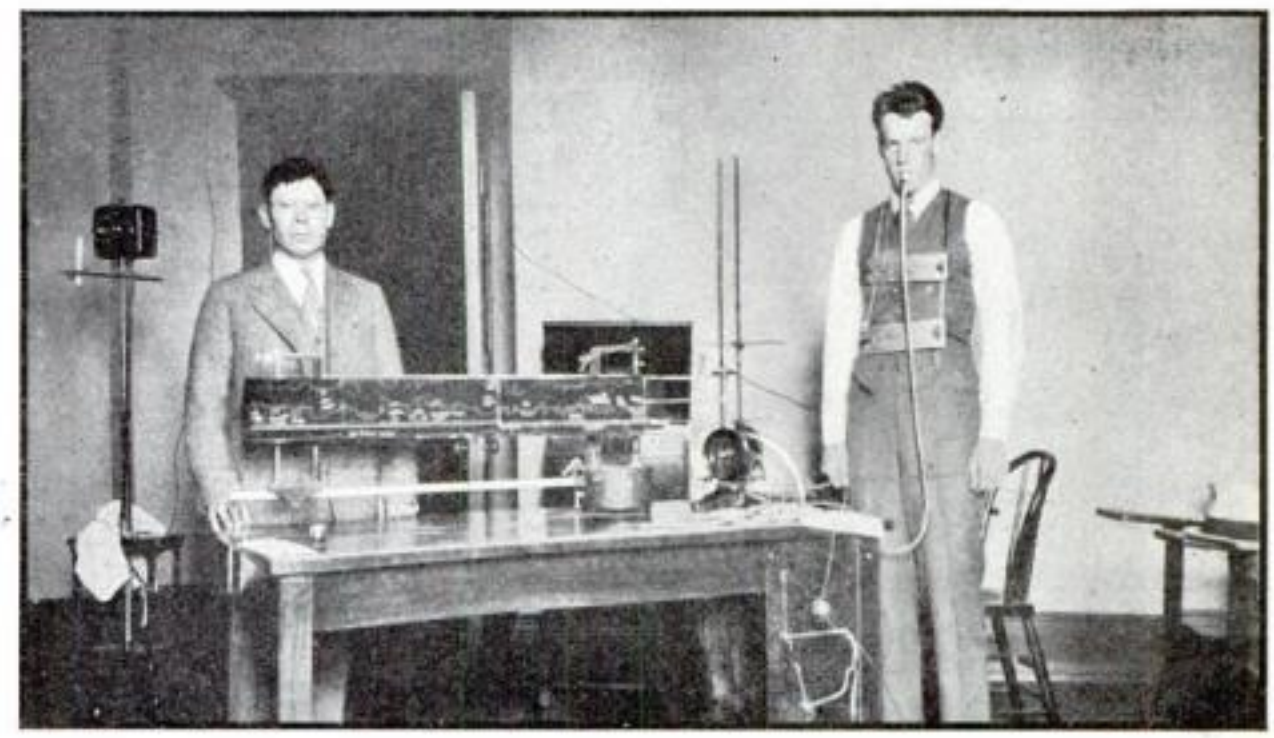


Below, the large lens set in rear window of car to extend driver's view of the machines on the road behind him.

A FRENCH inventor has perfected a device for improving the rearward vision of auto drivers, for use with the mirror that is standard equipment on closed cars. A large-diameter lens is mounted in the back window of a car. This greatly widens the driver's field of vision, enabling him to see the road back of his car, with a clear view of following machines. This is an improvement on the plate glass rear windows with which cars are usually fitted, which enable the driver to get at times only a partial view of the machines that may be following him. The rear window lens can be attached by the motorist himself in about five minutes.

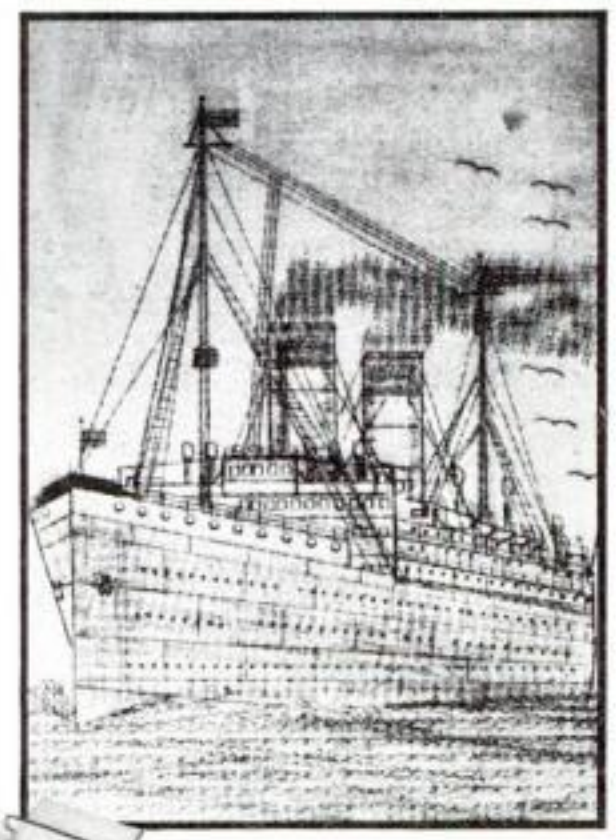
"BLOW HARD" APPARATUS TESTS PUBLIC SPEAKER

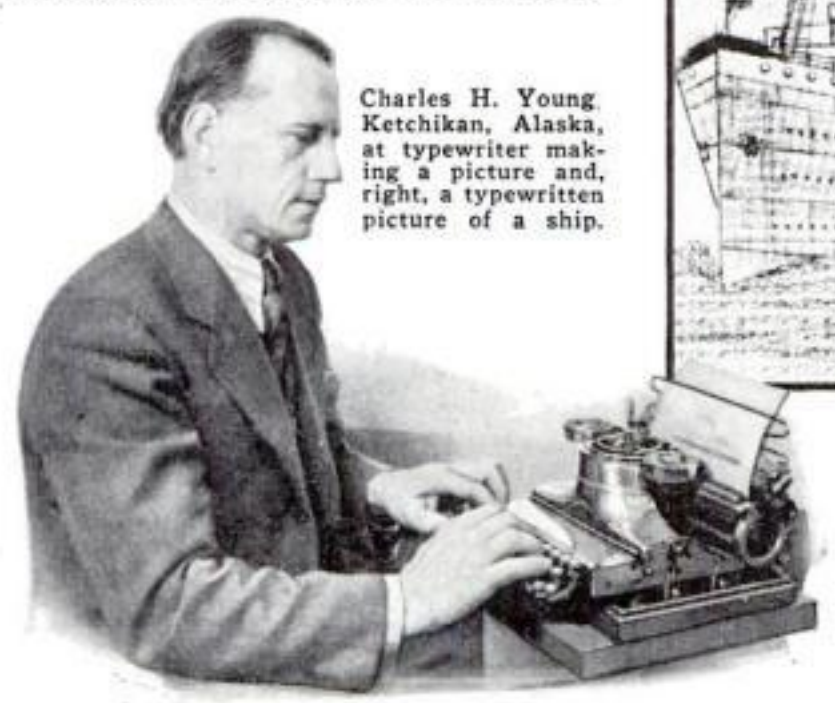
A STUDENT of public speaking at the University of Minnesota takes his examinations in a strange manner. With a metal harness strapped about his waist and chest he delivers a speech into a microphone. This is connected to loudspeakers before a group of judges. While these men listen to his oration, rating the speaker's ability, instruments connected to his body harness record his breathing while making the speech as shown in picture at the right. His ability to blow long and hard and strong is also measured. According to F. L. Holmes, assistant professor of speech at the university, a good public speaker must be able to blow long and steadily. In other tests of a speaker's pitch range, apparatus including an amplifier and neon tube is used.



MAKES PICTURES ON HIS TYPEWRITER

MAKING pictures with his typewriter is the unusual hobby of Charles H. Young, of Ketchikan, Alaska. His tool is a stock model of a machine with several fonts of type, intended for technical writing. Young's work combines ingenuity at using these characters with his skill as an artist. Marine scenes are his favorites. A sea gull is represented by a pair of parentheses, and rows of periods make the portholes of a ship. The accompanying picture shows the liner *California* entering harbor, and was typed by Young upon a piece of satin ribbon. For other designs he uses sheets of ordinary paper, up to eight by eleven inches. He makes no outlines to guide him, and each line in the picture is made with the typewriter. He uses no pen or pencil.





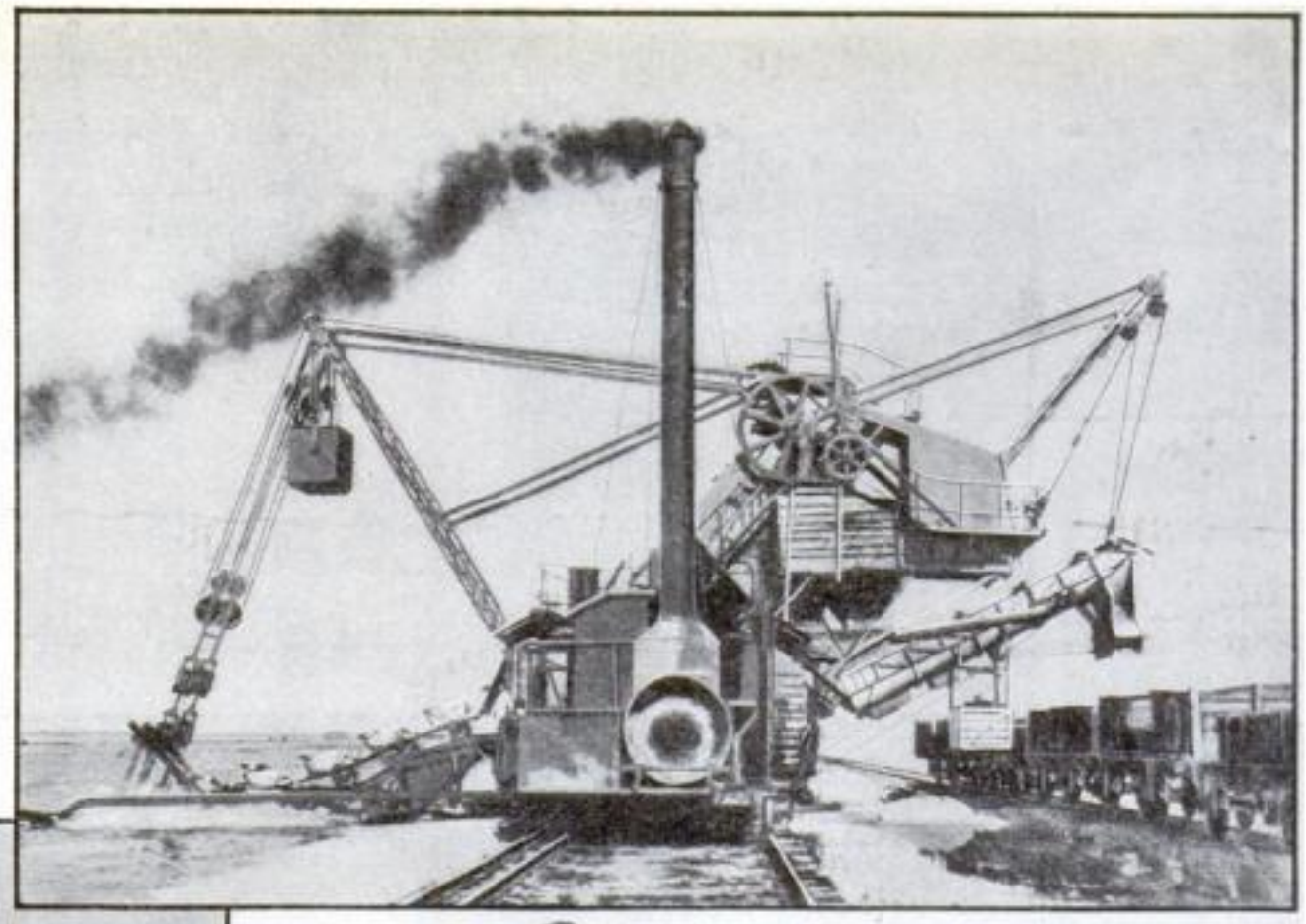
Charles H. Young, Ketchikan, Alaska, at typewriter making a picture and, right, a typewritten picture of a ship.

TIRE CHAINS REPAIRED WITH METAL SLEEVE

AUTO tire chains, according to the manufacturer, are quickly mended with a metal sleeve that slides from one side to the other of a repair link. The sleeve is first pulled to one side of the repair link, the other end of which is hooked into one of the free links where the chain is broken. Then the sleeve is pushed as far as possible under the attached link while the opposite end of the repair link is hooked to the other free end of the cross chain. After this, the sleeve is moved to the center of the repair link where it is sufficiently large to prevent either end of the cross chain from slipping off. It is said that this device makes possible an emergency repair of broken links without serious loss of time. Motorists who expect to use chains frequently can easily carry a number of the repair links in the car's door pocket.

SALT DIGGER'S SHOVEL OUSTED BY BIG DREDGE

MODERN methods of mining salt on Lake Baskunchak near the northwestern coast of the Caspian Sea show how rapidly the new is replacing the old in Russia. Formerly camels and horses drew crude wagons out into the shallow waters of the lake, while men waded around and dug the salt up by hand. Now a roaring steam-driven mechanical monster crawls on tracks along the shores of the lake. Its huge boom with excavators and buckets dredges salt from the lake bottom and deposits it in waiting railway cars. Thus the output of a commodity in universal demand is enormously increased and the cost of production is lowered. The modern method is shown at right; the old way below.



This steam-driven dredge scoops salt from the bottom of Lake Baskunchak and loads it on waiting cars, thus doing the work formerly done by hand as at extreme left.

LITTLE TELESCOPE USED TO SEEK SITE FOR BIG ONE

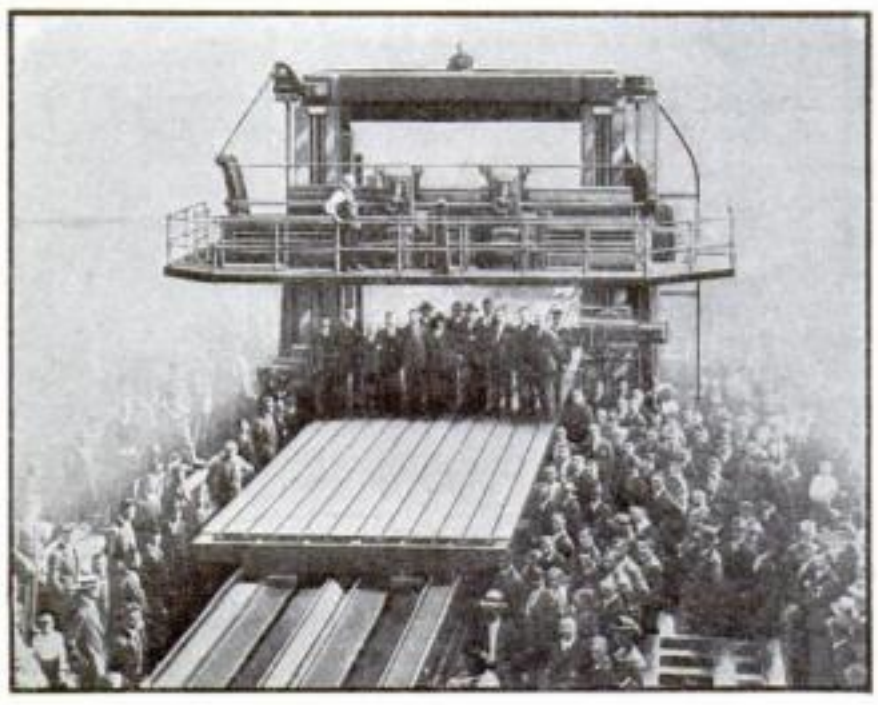
NOT primarily to look at stars was this new type of twelve-inch reflecting telescope designed by Pasadena, Calif., optical experts. Several of the instruments will be used to investigate "seeing conditions" at eight or ten possible locations for what will be the biggest telescope in the world—the 200-inch reflector planned for the California Institute of Technology. The smaller telescope is a powerful instrument in its own right, however. When it is turned toward Jupiter the planet is so magnified that it fills the field of view.

"GUNSIGHT" PARKS CAR

JUST as a rifle sight aims the bullet, so a new accessory for the car helps its driver to guide it past garage doors or park it near the curb. A twelve-inch upright rod is clamped to the fender. By looking past the knob at its top the driver is able to judge how much room he has.

USE DIAMOND TO DRAW FINEST WIRE

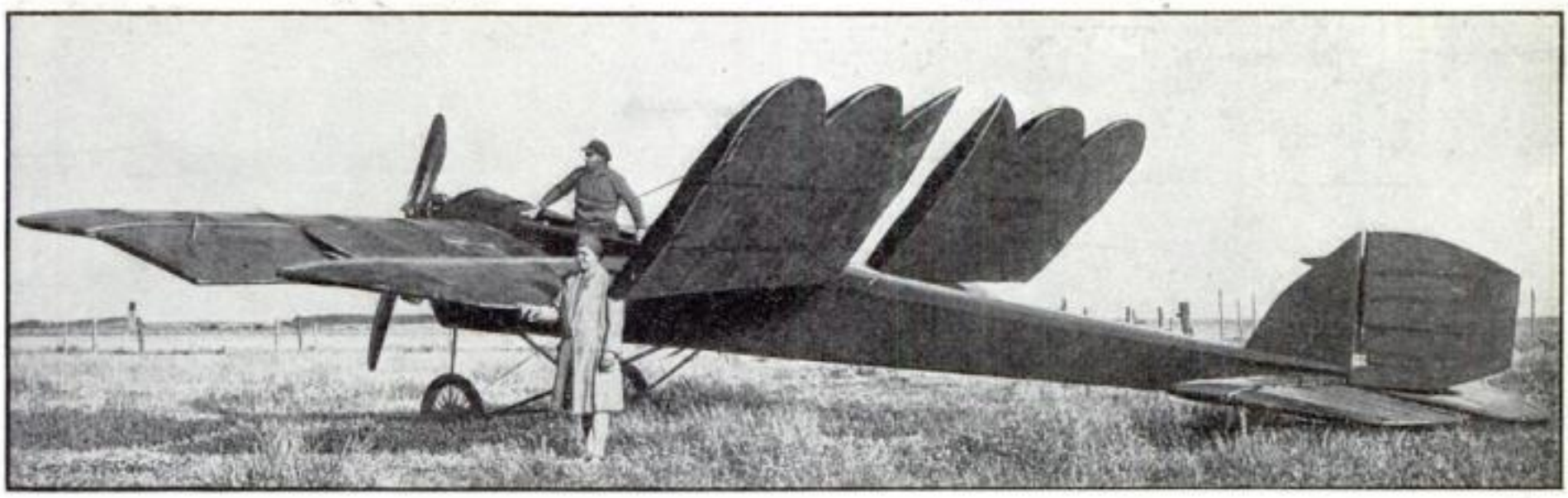
WIRE one fifth as thick as a human hair has just been drawn out of tungsten metal by the engineers of the Westinghouse Lamp Company at Bloomfield, N. J., who pulled it through a tiny hole bored in a diamond. It is used for the filament of a special type of electric lamp. Formed into a coil for the filament, it gives 1,500 turns to the inch with no two touching.



GIANT MACHINE PLANES HUGE STEEL BLOCKS

A PLANING machine recently completed in Germany is designed to smooth off blocks of iron or steel, as a carpenter planes a piece of wood, on an enormous scale. Unlike the carpenter's plane, which moves over the work fixed in place on a bench, the cutting tools of this monster machine are stationary as in smaller types, while the work moves. It is rigidly fixed in place on a table about fourteen feet wide by nearly forty feet long. This table moves backward and forward, carrying the work past the tools. These are mounted on a framework that straddles the table. Two tools are mounted above the work and one on either side of it. The people standing on this machine in the photo give some idea of its size.

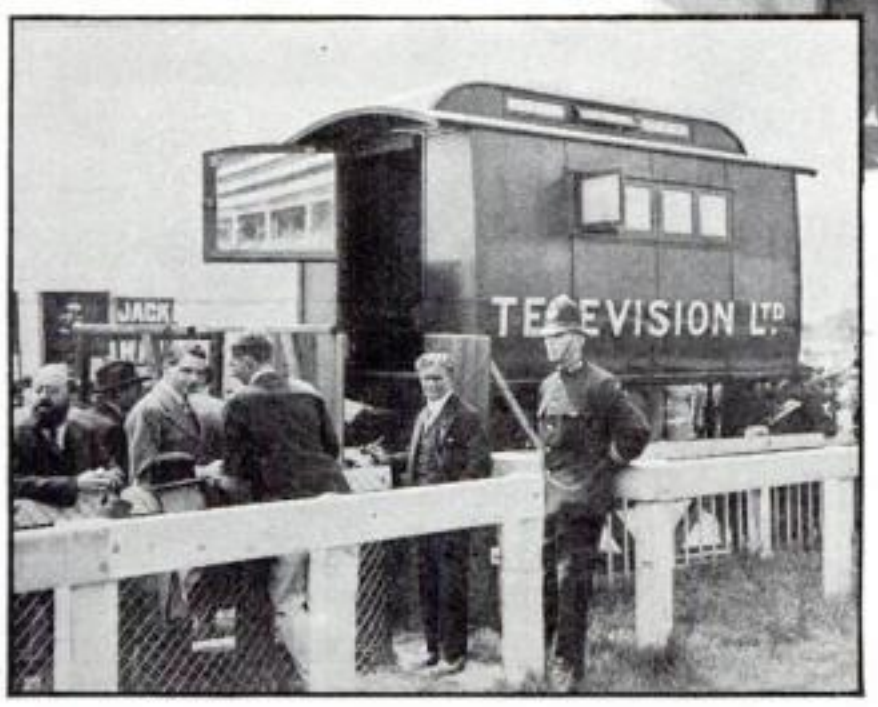
"Turkey Airplane" Has Third Wing to Help It Climb



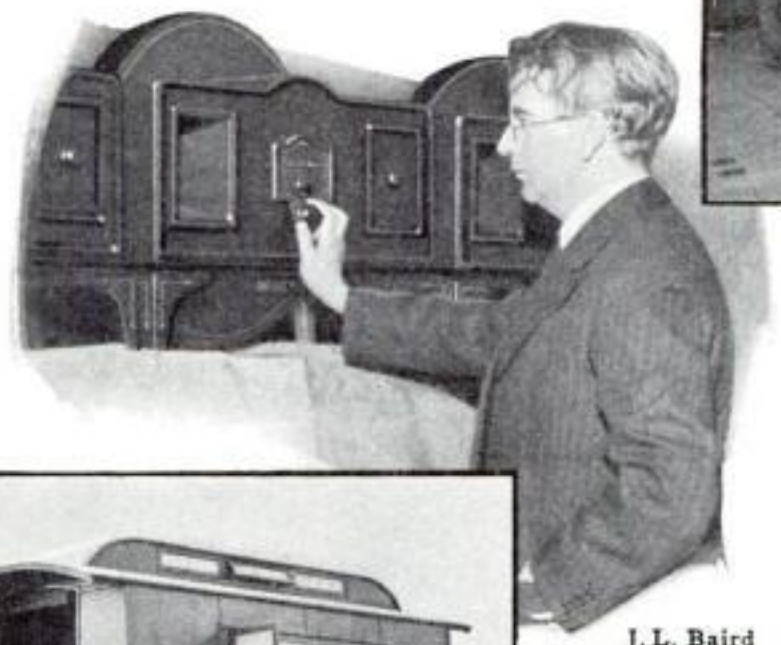
DUBBED the "turkey airplane," a strange craft invented in Germany has three sets of wings. The hindmost pair may be tilted sharply upward, giving a striking resemblance to the tail feathers of the domestic fowl from which the plane takes its name. The designer, J. Sporrer, declares that this unusual wing surface provides protection from a nose dive out of control, and also enables the craft to climb upward in a take-off at angles as steep as sixty degrees. The photo shows hind wing tilted.

BROADCAST VIEW OF HORSE RACE

WHILE radio men are still talking about the future broadcasting of sporting events by television, the first experiments along this line have been made in England where, it is said, there are 5,000 home television sets in use. Experimental broadcasts are being made by John L. Baird, television pioneer, of the finish of horse races. While individual horses cannot be recognized, it is said their forms can be seen crossing the finish line. Those who do not have television receivers of their own visit Baird's London studio to see the races in two-by-five-inch windows. The views are transmitted from a wagon resembling an abbreviated street car parked beside the track. Because the interesting part of a horse race is at the finish, such a broadcast is possible with a stationary transmitter. Eventually it may be possible to "televise" an event like a football game by placing several transmitters on a field and switching from one to another as center of play moves.



Below, the television transmitting wagon at the side of race track.



J. L. Baird in London studio sees distant race.

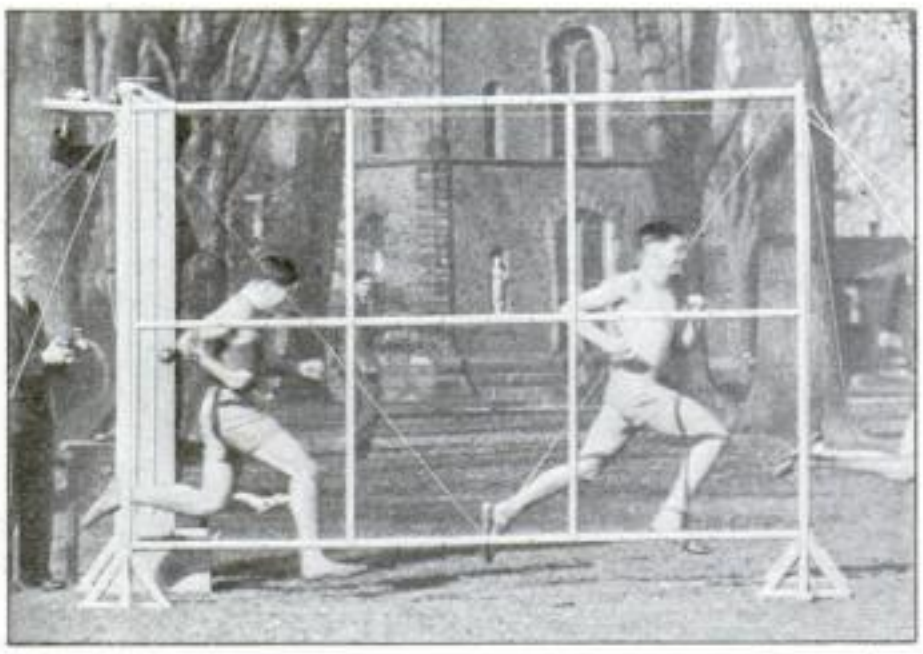
TRAIN LINEMEN INDOORS

SINCE an incompetent linesman working on a high-voltage electric line is flirting with death, an Ohio electric concern has constructed an examination room to make sure its employees are properly trained. Seven transmission poles, standard in everything but height, rise from the floor of this room. They are strung with wires just as they would be in actual service. A would-be linesman is required to take an examination by making connections on the wires. After he has completed the job, a 4,150-volt current is shot through the wires to test his splices.

NEW SCREW DRIVER FITS KEY RING

A NEW pocket screw driver, invented by a Boston man, is no larger than a half dollar and may be carried on a key ring. Four short blades project from the circular portion, each of a different width, giving a screw driver that fits most screws. It is useful on radio sets and sewing machines.

WHY SPRINTERS CAN'T RUN FASTER



Falling ball seen at left shows speed of runners past framework.

A QUEER structure resembling an unglazed window frame was used by Professor Wallace Fenn, of Rochester University, N. Y., in testing the speed limit of runners. Sprinters raced in back of the apparatus while a movie camera filmed their actions. Falling croquet balls left a record on the film of the time required to pass the structure. Round black spots on the sprinters' neck and waistbands furnished points on the films by which the movement of the runners' bodies could be studied. Professor Fenn learned, from this and other experiments, that the human body has about reached its maximum speed limit, as typified by world's running records. The reasons for its inability to achieve greater speeds lay in its internal resistance—that is, the muscular effort required to swing the legs.

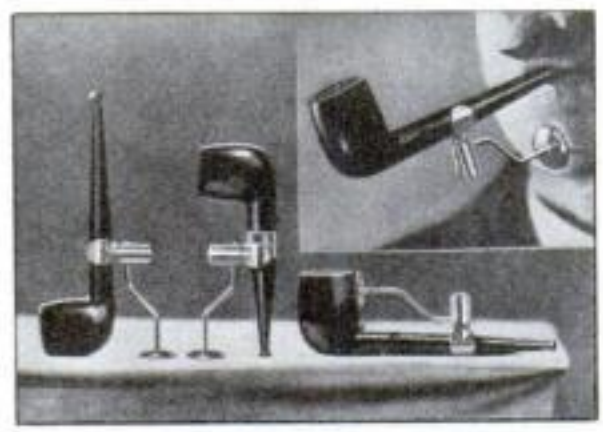
COLORED LIGHTS WARN OF INACCURATE AUTO PART

GREEN, amber, and red lights control a parade of small auto parts as they pass through a new inspecting device at a Lansing, Mich., motor car factory. If the amber light goes on as a part is placed between its jaws the operator knows it has been machined to within allowable limits above or below a certain dimension. If the red light flashes she knows an oversized part has crept into the line. Should the green light flash on, the operator knows the part under inspection is below the limits of size. The device is adjustable from one one-hundred-thousandths of an inch above and below certain dimensions. When work is put between its anvils, the upper one forces a block upward, moving a delicate lever from side to side. If the work is within certain limits specified the lever will rest on a central contact point that completes the circuit lighting the amber lamp. If it is over or under size the lever moves to one side or the other, coming to rest on contact points that work either the red or the green light.

FIVE EXTRA POINTS IN MAGAZINE PENHOLDER

SCHOOL children, who wear out or lose pen points rapidly, may be helped by a new "magazine" penholder. A cylindrical cavity within it holds five extra pen points. When a new one is needed the holder is opened, a point extracted, and the holder twisted back in place again.

This penholder is a magazine in which extra pen points are held ready to be used.

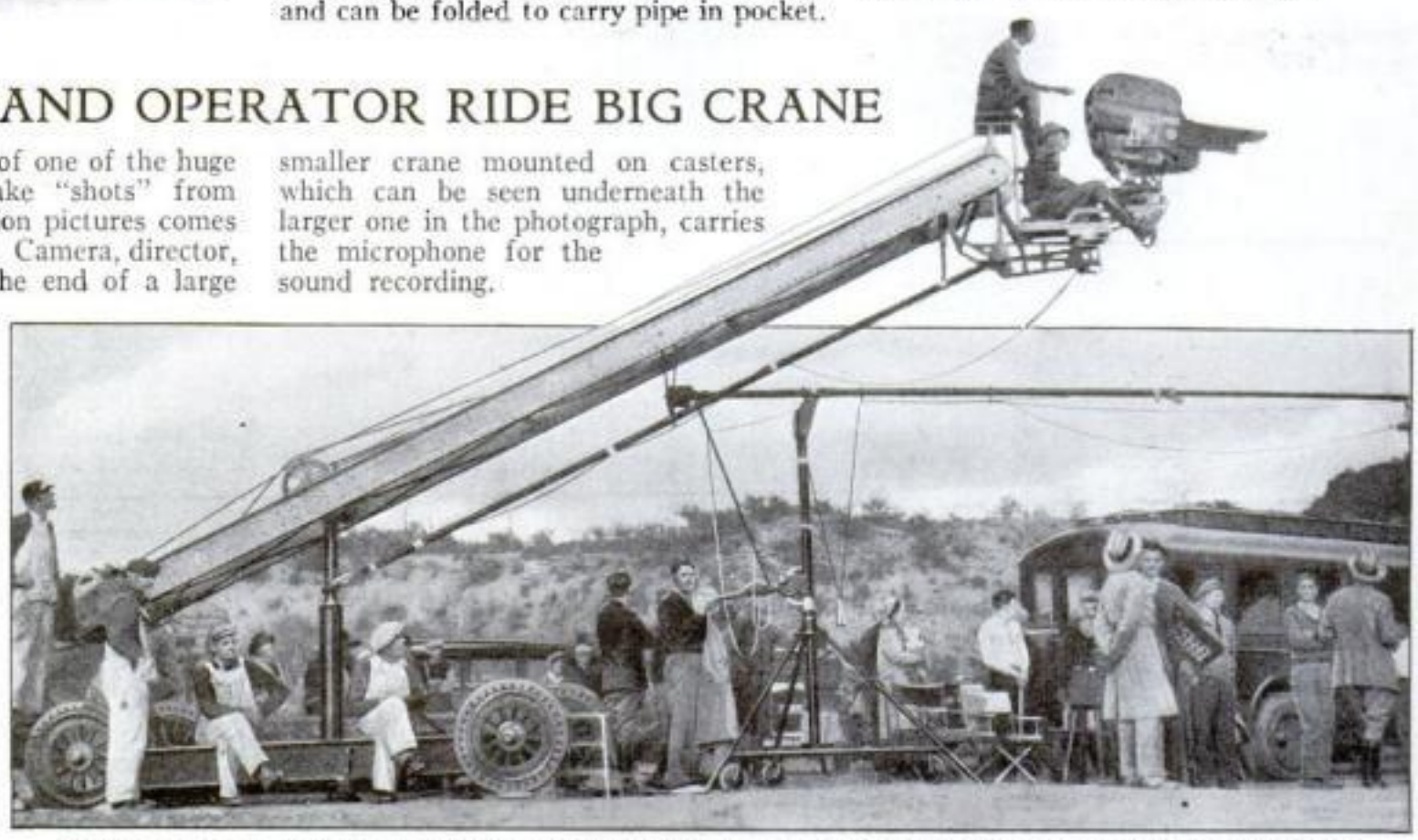


SUCTION CUP ON CHIN HOLDS SMOKER'S PIPE

FROM England comes a device that supports a pipe in the mouth of the smoker. A small suction cup rests upon his chin, and to this a bent rod is attached, which carries most of the pipe's weight. The holder also serves as a stand for the pipe and can be folded to carry pipe in pocket.

CAMERA AND OPERATOR RIDE BIG CRANE

A REMARKABLE view of one of the huge camera cranes that take "shots" from unusual angles for motion pictures comes from Hollywood, Calif. Camera, director, and operator ride on the end of a large girder of duralumin. Mounted on a rotating base, and capable of movement up and down as well as sidewise, this device gives the photographer a bird's-eye angle from which to shoot the scenes. It is carried on a truck chassis that can be towed as a trailer when the movie caravan goes on location, or moved about the lot as required when they are working nearer home. A smaller crane mounted on casters, which can be seen underneath the larger one in the photograph, carries the microphone for the sound recording.

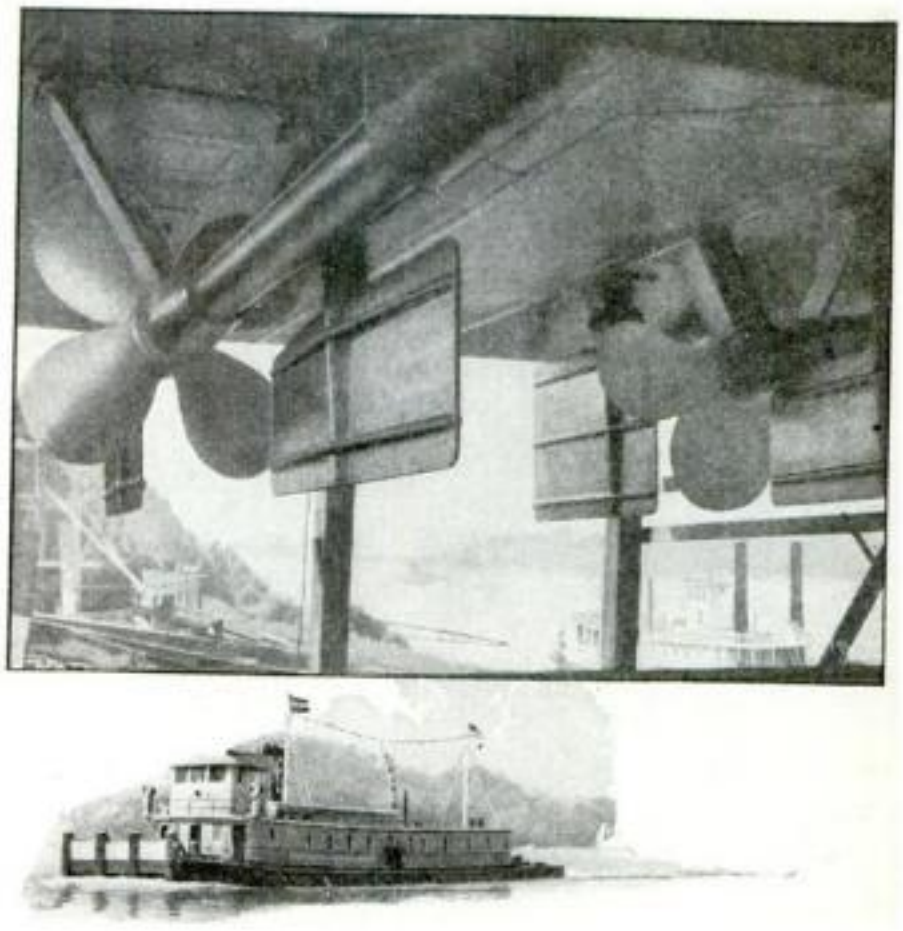


Movie scenes can be "shot" from unusual angles with this crane, which holds camera, photographer, and director.

TWO EAGLES FOR BRIDGE WEIGH 785,000 POUNDS

THIS fierce and medieval looking piece of statuary is one of the two stone eagles designed for the Soldiers and Sailors Memorial bridge at Harrisburg, Pa. Each eagle is made of Indiana gray limestone, contains thirty-five separate pieces, and weighs approximately 392,500 pounds. One each of the huge stone birds has been placed on the pinnacle of the 143-foot pylons at the bridge's entrance.

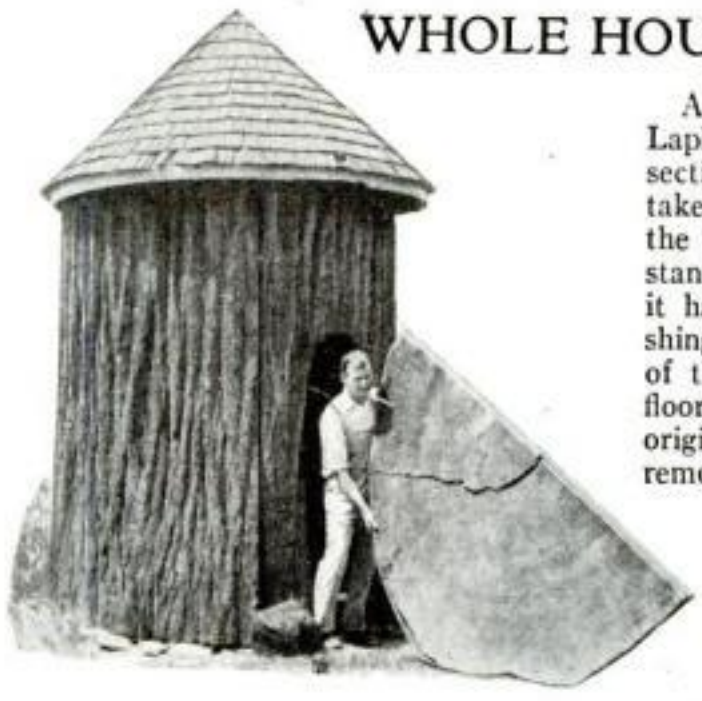
FOUR RUDDERS GUIDE MISSISSIPPI BOAT



So STEERED and propelled that it can "turn on a dime" is the newly commissioned Mississippi River towboat *William Dickinson.* To help it negotiate the narrow and tortuous channels and to pass between bridge piers, it boasts four rudders—one forward and one behind each propeller, all worked by hydroelectric machinery instead of by hand. The two six-foot propellers run independently, forward or astern. By juggling his rudders and propeller speed the pilot can turn or maneuver his craft even when it has no forward velocity—an invaluable aid to safety, since a river towboat drifting uncontrolled in the current would be in great danger of running aground. In place of the long familiar twin smokestacks reaching thirty feet above decks, the new craft has one stumpy funnel six feet high, and a Maxim silencer softens to a low hum the sound of its Diesel motors.

GASKET FOR PIPE JOINTS NOW COMES IN CANS

A "LIQUID gasket" that comes in cans has just been introduced in this country. This gray paste, made of a secret combination of graphite and oils, is applied to any joint with an ordinary putty knife, and forms a joint that the manufacturers claim will remain tight under 1,500° F. heat and pressure of 5,000 pounds to the square inch. it has wide use in home, garage, and factory.

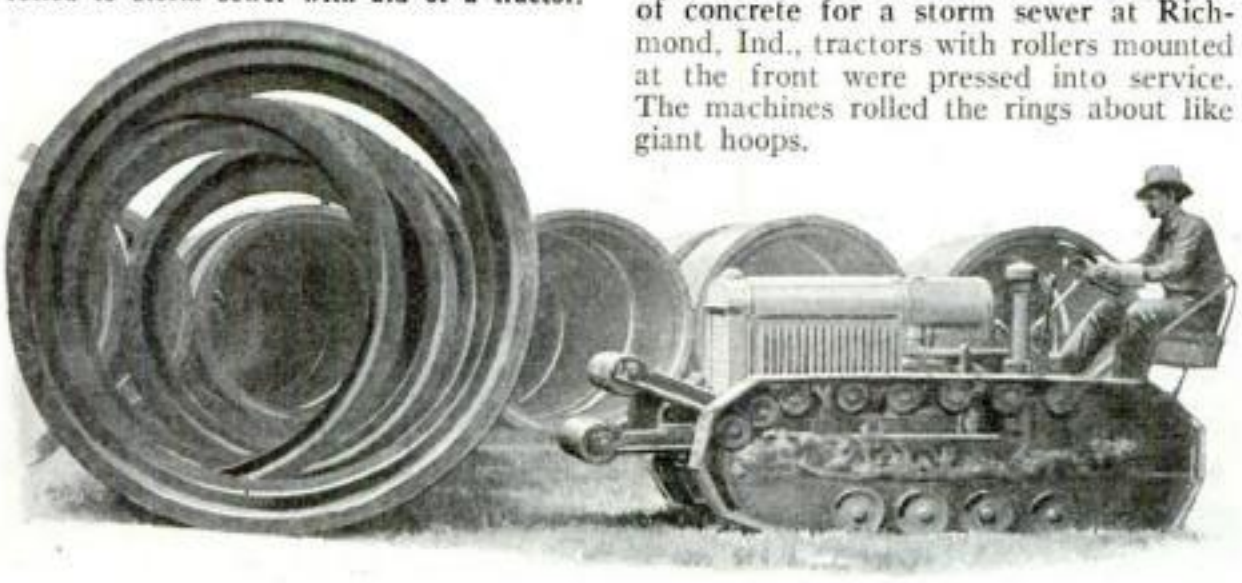


WHOLE HOUSE FROM ONE LOG

A SUMMER house owned by Arthur C. Lapham, of Carlisle, Mass., is a single section of a giant California redwood tree, taken from a point about fifty feet above the ground. The hut was constructed by standing the huge tree trunk on end after it had been hollowed out and putting a shingled roof over the top. The interior of the room formed by the trunk has a floor made of a single cross section of the original tree, cut in half, so that it can be removed without moving the entire hut, as can be seen in the illustration at the left. The hut now stands on Lapham's lawn and is used as a summer house. It is about thirty feet in circumference.

TRACTOR ROLLS GIANT CONCRETE RINGS

Fifteen-thousand-pound rings of concrete are rolled to storm sewer with aid of a tractor.



TO SOLVE the problem of handling rings of concrete for a storm sewer at Richmond, Ind., tractors with rollers mounted at the front were pressed into service. The machines rolled the rings about like giant hoops.

STYPTIC PENCIL FITS IN SHAVING BRUSH HANDLE

ORDINARY styptic pencils for treating razor cuts easily lose themselves in the medicine cabinet and when needed in a hurry oftentimes are difficult to find. A recently patented shaving brush carries a styptic pencil fitted into the handle of the brush. The pencil can be unscrewed when needed, and the user is assured that it has been kept in a sanitary condition in the handle.

Styptic pencil, seen above, fits into handle of shaving brush.

How *the* World Looks *to a* FISH

Light Rays Refracted by Water Give Distorted View of Things at Surface

By GAYLORD JOHNSON

LET us try to put ourselves in a brook trout's place, see what he sees, and understand the strange topsy-turvy world that a law of optics creates for him.

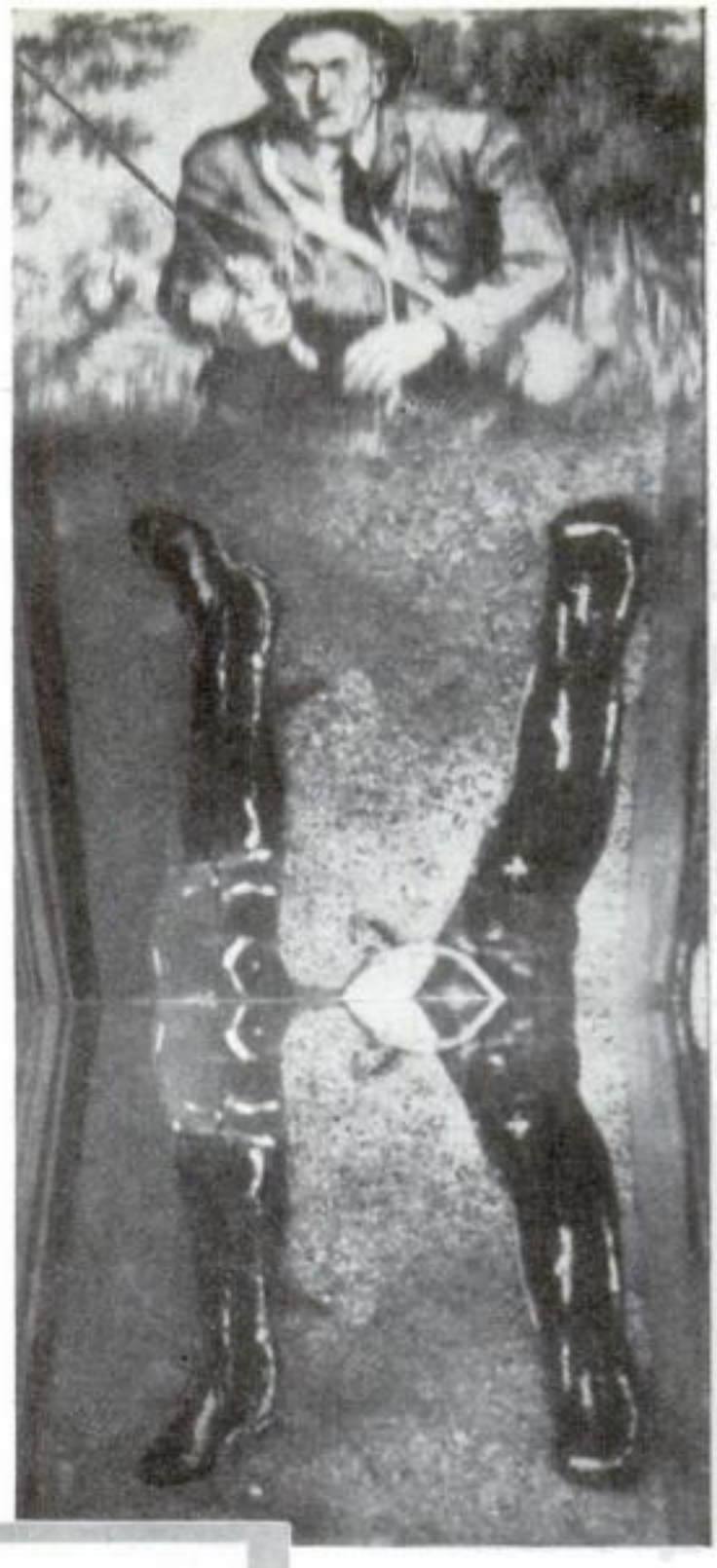
Since it is obviously impossible to dive into a quiet pool of the trout stream and observe the odd views the fish gets from the bottom, we must find some way to duplicate these same effects of light under laboratory conditions.

I did this with a specially built aquarium of the type illustrated below. One of the ends is set at a forty-eight-degree slant, enabling the eye (and camera) to look upward through the water and get an undistorted view of what the fish sees. With the aid of this device I secured the fish-eye views that illustrate this article.

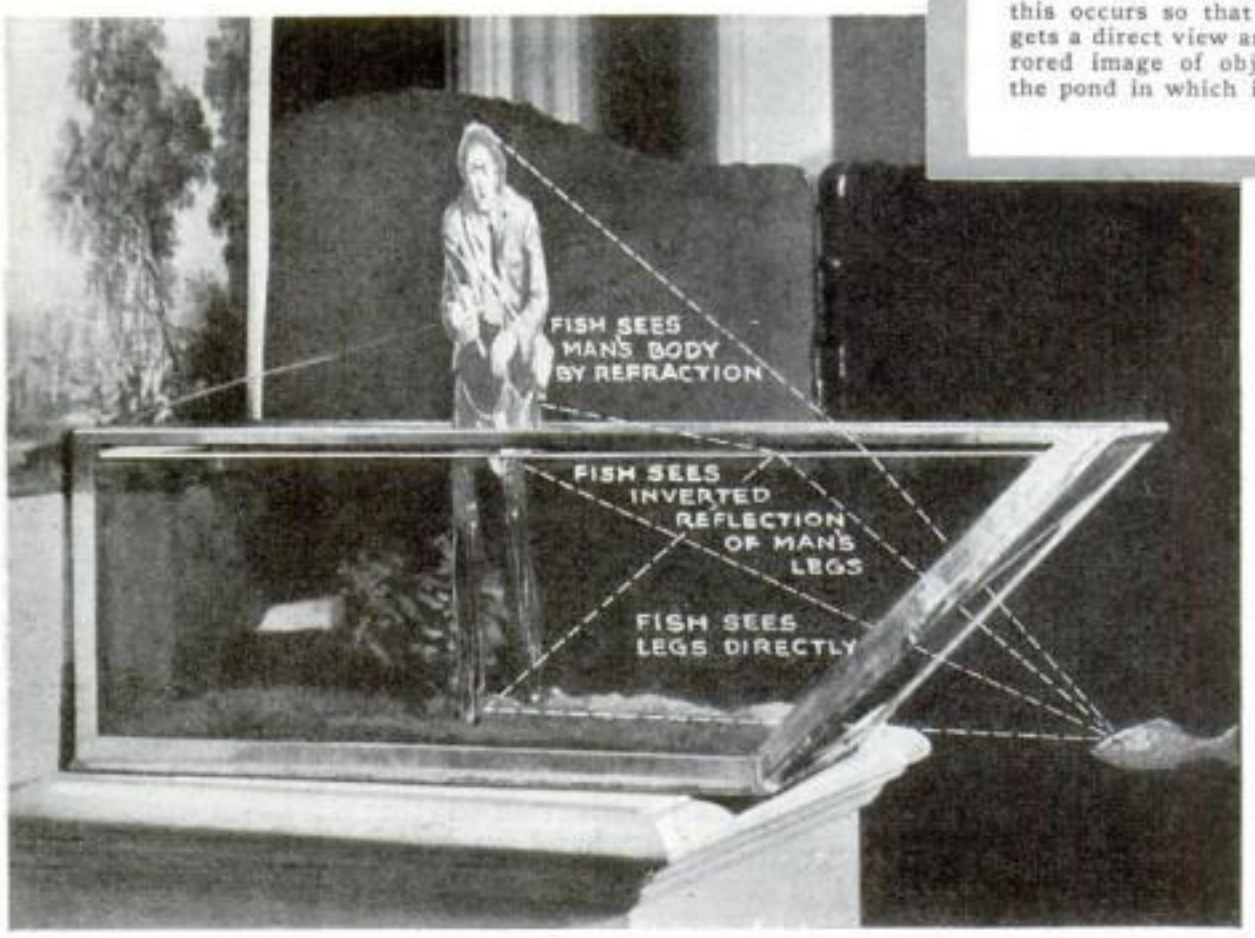
Now let us imagine ourselves shrunk, like Alice in Wonderland, to a few inches in height, clad in diving suits and standing on a scow equipped with an air pump and two stout sailors to operate it. The scow is floating, as you see, upon the surface of our aquarium pond.

The air tubes are all in order, our code of signals is arranged, our helmets are screwed on tight. You are to descend into the pond first, for I want you to observe, while standing on the bottom, the peculiar light effects that will occur as I am lowered toward the bottom.

WHEN you feel the pond-bottom under your feet, you look upward through the windows of your helmet. Above your head is the square bottom of the scow. Around it you get a view of the sky and the trees surrounding the pond, but you will at once notice that this view is circular and sharply limited. Beyond the edge of this round view you no longer see external objects. Instead, you see, upside down, the objects on the bottom of the pool! It is as if you looked out at the world through a large round porthole in a mirror. This photograph shows only an arc of the complete porthole. The camera lens did not take in a wide enough angle to include it all, as your eye would.



Above, the flattened four-legged picture of a man which is what the trout sees as the light is refracted and reflected by the water. Below, diagram showing how this occurs so that the fish gets a direct view and a mirrored image of object near the pond in which it swims.



Note how the sandy bottom, the pond weeds, and the fish near the bottom are all reflected, *upside down*, on the under surface of the pond. This picture shows about half of the scow.

NOW walk a few steps away from your position and notice how the square bottom of the scow moves out of the "porthole" or "window" and occupies a place entirely in the surrounding "mirror." You will see figures appearing in the porthole. They are myself, clad in my diving suit, and the two sailors working the pump that is supplying you air through the hose. Notice how sharply the view is cut off by the edge of the "porthole." We seem to float in the air some distance above the scow! The feet of our figures are hidden just as completely as if the surrounding "mirror" were opaque, instead of being, as we know, merely transparent water. Beyond the arc of the window you see reflected, as before, the pond-bottom.

Photographs show the topsy-turvy world in which the fish lives with its distorted images.

An object descending into the water is seen inverted in image and upright through water.

One object, as it breaks surface of the pond, becomes two to the fish, as in this picture.

Why do these things happen? We shall find out when we investigate the law of optics that causes the effects. But before we get that far let us observe any other strange views that the fish sees under the water.

Watch as you see me being lowered over the side of the scow. You see my head through the porthole, and at the same time you see my feet breaking through the surface. They are doubled, upside down, by the mirror that the surface forms. If you had a waterproof movie camera, and took my picture as I descended, the strip of film would show strange views.

Note how each part of me that sticks through the mirror is repeated upside down until I am completely immersed. See how, for a moment, my reflection does a "headstand" on the crown of my helmet. And then we separate, I going down to walk on the pond-bottom and my reflection going up to walk, flylike, upon the mirror ceiling of the fish's pond room.

AS I reach the bottom your camera still sees me twice—once directly through the water and once reflected, upside down, from the surface of our pond. But note how the lower part of me, from the waist down, disappears as it reaches the edge of the mirror where the window begins. You see right through the place where my legs ought to be and see the trees on the shore of the pond.

Now stop and realize for a moment what these phenomena mean to a brook trout. Suppose a fisherman is using what sportsmen call a "wet fly" that is meant to break through the pond surface and sink a little way into the water while the "cast" is being reeled in.

Just after the wet fly has broken through the mirror's surface it appears to be doubled in size, and a moment later it will seem to be *two* flies, that separate more and more from each other as the bait sinks farther below the surface. Does the trout know from experience that the *lower* bait is the real one, and that the *upper* one is an illusion?

Now, while you and I are still standing on the pond-bottom, looking at the world through the eye of a fish, let us imagine that an angler in hip boots wades into our pool. We see his feet far off through the water, and they are of course reflected on the mirror above. Then, through the "window," we notice the angler's head and shoulders as shown in the picture at the beginning of this article.

THE angler's face and body are flattened and widened, like the image in a distorting mirror. So the fish's visual idea of the fisherman is a strange four-legged creature, with a flattened head and shoulders seen arising between two of his feet—certainly a queer-looking picture!

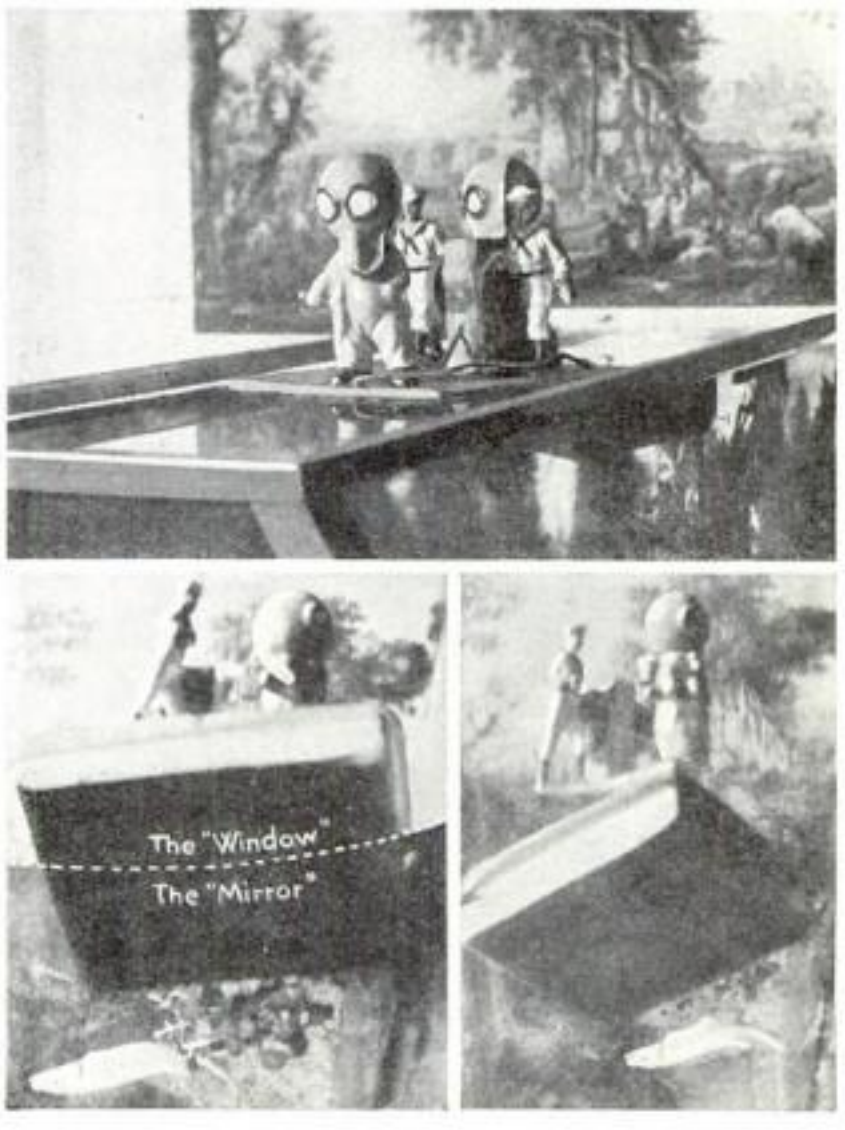
Let us now look into the optical law which causes all this interesting topsy-turvydom.

To begin with, let me remind you of a simple experiment that you probably have tried.

Place a penny in an empty teacup, and move your head until you see the penny go out of sight behind the rim of the cup. Then, without moving, pour water slowly into the cup. As the water rises in the cup, the image of the penny rises with it, until you apparently see it above the cup's rim. The rays of the light coming from the penny are bent *toward* your eye as they leave the surface of the water—thus enabling you to see around the edge of the cup and perceive the penny when it is actually out of your line of vision.

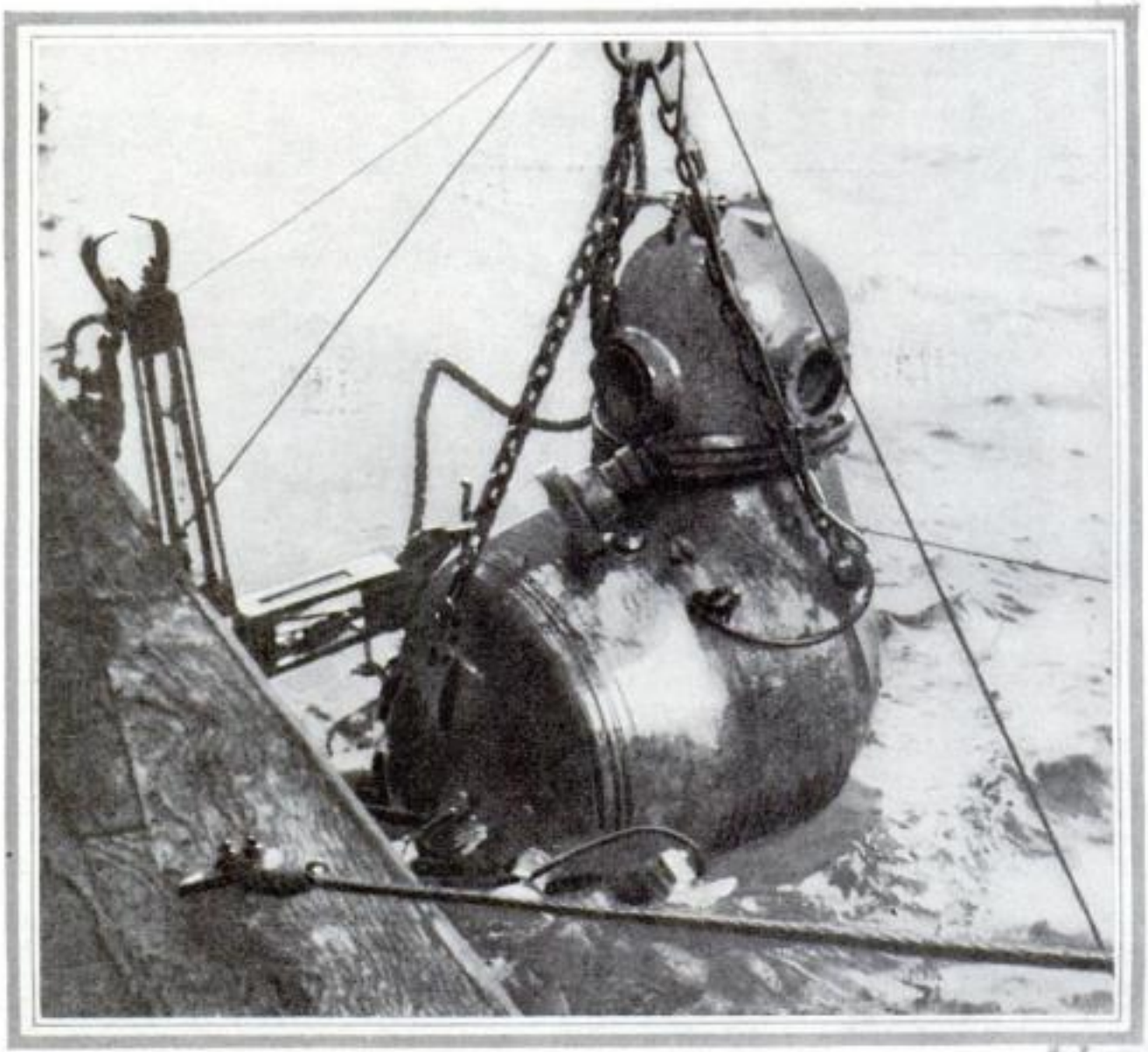
This law of refraction explains easily all the topsy-turvy views we have just had from the bottom of the trout pool. A simple diagram drawn upon a side-view photograph of the aquarium and the fisherman, placed just as he was when I took the "fish's-eye view" of him, will make the phenomena clear.

When light travels from one transparent medium to another—in this case the two mediums are *(Continued on page 117)*

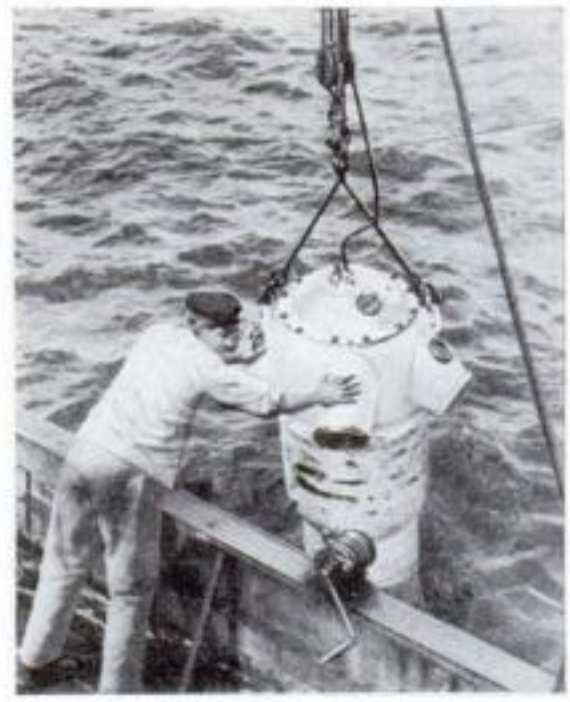


Above, figures on the scow as they appear to human eye and at right, as they are distorted and reflected as light strikes water. Dotted line is surface of pond which is a window to the fish and also a mirror that reflects objects, thus giving fish a double set of images.

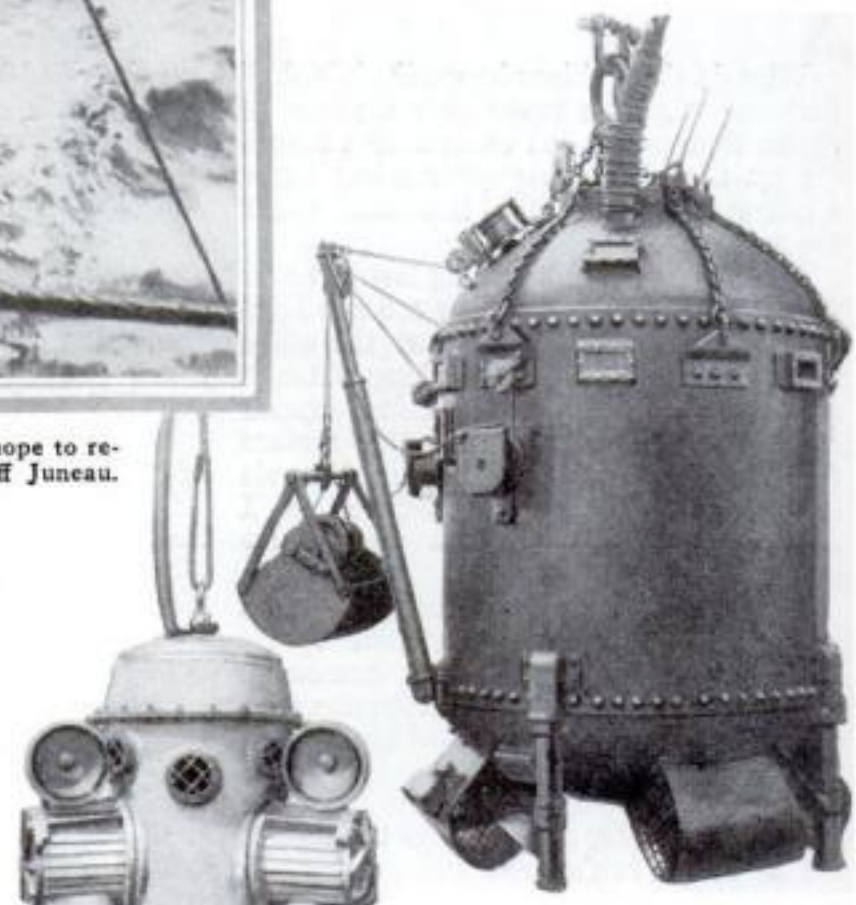
Steel Diving Suit Spurs Search for Ocean Gold



This one-man submarine is equipped with a lazy-tongs arm, with which divers hope to recover $3,000,000 in gold nuggets that went down when an iceberg hit a ship off Juneau.



Thick walled chambers like this one are used in search for treasure off France.



Above, a self-propelled diving bell to be used in dynamiting wreck near Virginia Capes. At left, diving suit, with headlights.

THREE million dollars in nuggets of gold! That is the lure that set a small band of adventurers sailing from Seattle, Wash., a few weeks ago. It lies in the hold of the ill-fated S. S. *Islander,* sunk in collision with an iceberg off Juneau, Alaska, thirty years ago. Now the Curtis-Wiley expedition is going down 365 feet after it with a new type of diving suit—a veritable one-man submarine of steel. This device's lazy-tongs arm will grasp valuable objects and attach cables to the wreck so that the salvage ship *Griffon's* forty powerful winches can attempt to raise it entire.

Every seaboard is strewn with derelicts sent to the bottom in war or by the fury of storms. Many hold fabulous riches in jewels, gold, and pieces-of-eight. When rubber diving suits were the style, only treasure in the shallowest water could be reached. But the latest metal diving armor will withstand the crushing pressure of water several hundred feet deep. Underwater lamps have recently been perfected to guide subsea adventurers. It is no coincidence, then, that at least four undersea treasure-hunting expeditions are planned for this summer or are already under way.

OFF the Virginia Capes lies the S. S. *Merida* in some 200 feet of water. Repeatedly her hulk has defied salvagers' efforts to get at the $4,000,000 she holds —including, it is said, the crown jewels of Emperor Maximilian and the rubies of Empress Charlotte of Mexico. Now Harry L. Bowdoin, of Whitestone Landing, N. Y., plans to dynamite a hole into her strong room from a self-propelled diving bell that roams about the ocean floor under its occupant's control. Then a diver in another of his inventions, a deep-sea diving suit with headlights on the shoulders, will try to enter and recover the jewels.

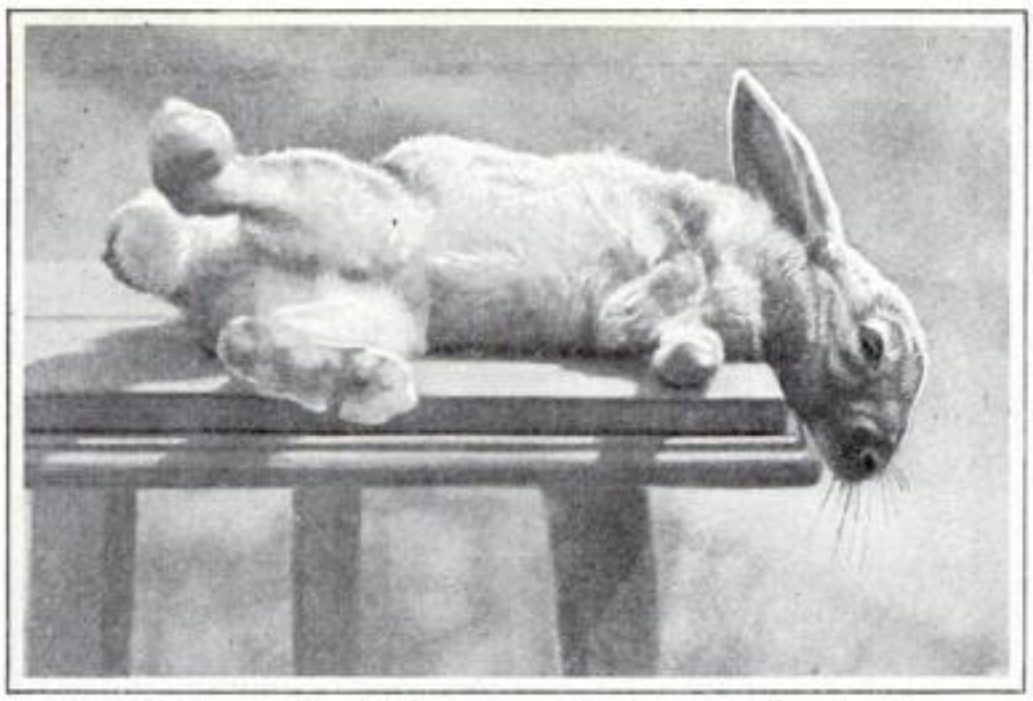
A MYSTERY yacht, *Reclaimer,* joined the summer's crop of treasure hunters not long ago. She steamed out of Sunderland, England, for a secret destination, her decks rattling with the latest in diving bells and suits. Rumor said she might be headed for the torpedoed *Lusitania* off the Irish coast.

Perils beset deep-sea treasure hunters. When the Italian salvage ship *Artiglio* sought gold last year in the sunken liner *Egypt* off the French coast, a premature explosion of dynamite blew up the salvage ship and killed several of her crew. Now divers of the *Artiglio II* are on the scene carrying on the work of their unlucky predecessors.

Richest known of treasure hauls is the $35,000,000 taken from the sunken S. S. *Laurentic,* off the Irish coast in ninety feet of water, shortly after the Armistice. This liner was sunk by a German submarine in 1917. The treasure-hunting expedition had the advantage of shallow water, but the derelict's sides bulged and her decks collapsed. Divers exploring her interior were in constant fear for their lives. Finally, after extensive dynamiting of her hull, every single coin she contained was recovered. Greater wealth is still untouched—probably the biggest lode, $100,000,000 in gold and silver that went down with a fleet of scuttled Spanish galleons in Vigo Bay, Spain. Of course some of the most valuable treasures lie at such great depths that nothing as yet designed will be able to get to them, but gold-laden wrecks aplenty are well within striking distance of adventurers equipped with diving suits incorporating the latest improvements.

ANIMALS that can be

Hypnotized



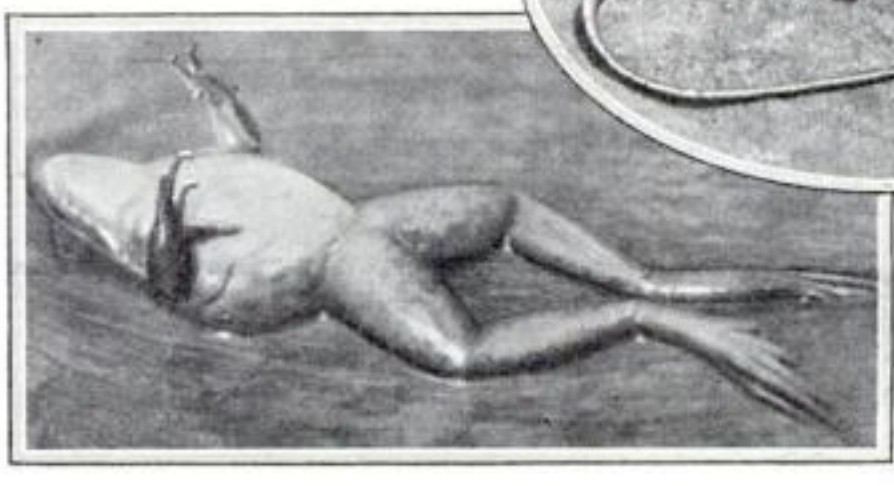
This rabbit is not dead but in an hypnotic trance. Laid on the edge of a table with its head hanging it will remain quietly there for some time unless its sensitive ears are touched, which instantly wakens it.

CAN animals be hypnotized? "Yes," is the verdict of experimenters who have actually put them into artificial sleep. Science has as yet no satisfactory explanation for such strange phenomena as are illustrated by the unusual photographs on this page, but that they occur is undisputed. An experimenter grasps a struggling rabbit and swings it up and down several times. Then he throws it on its back and holds it still for several seconds. Its struggles cease. It is in a hypnotic sleep. Rhythmic swinging will also hypnotize a chicken. A faster way, however, is to place the fowl on a table with its legs beneath it, and hold down its head and neck with the beak resting on the table. Merely laying a frog on his back and holding him there covered with the palm of the hand until he stops wriggling is sufficient to put him in a trance. This method works with a number of small animals, among them our native so-called chameleon, a swift little lizard. Snakes may be hypnotized by being placed on the back and gently but firmly held down. One of the easiest of all creatures to hypnotize is the crayfish. Placed on his head, forming a triangle with his large claws, his back is stroked for a minute or two and he then rests motionless for minutes on end. All of these creatures resist being placed in a trance. But once asleep, their muscles become weak and their breathing slow and regular. Probably what happens to them is not a "hypnotic trance," as the term is applied to human beings, but rather some unexplained sort of paralysis of the muscles.

In hypnotizing a rabbit, the animal is held firmly and with a rhythmic motion it is swung up and down by the operator as illustrated in photo above and at left.

One of the easiest creatures to hypnotize is the crayfish. Stood on its head, as shown at left, its back is stroked and the animal passes into a trance. In oval, a little lizard is hypnotized by being placed on its back. At bottom a frog is similarly put to sleep.

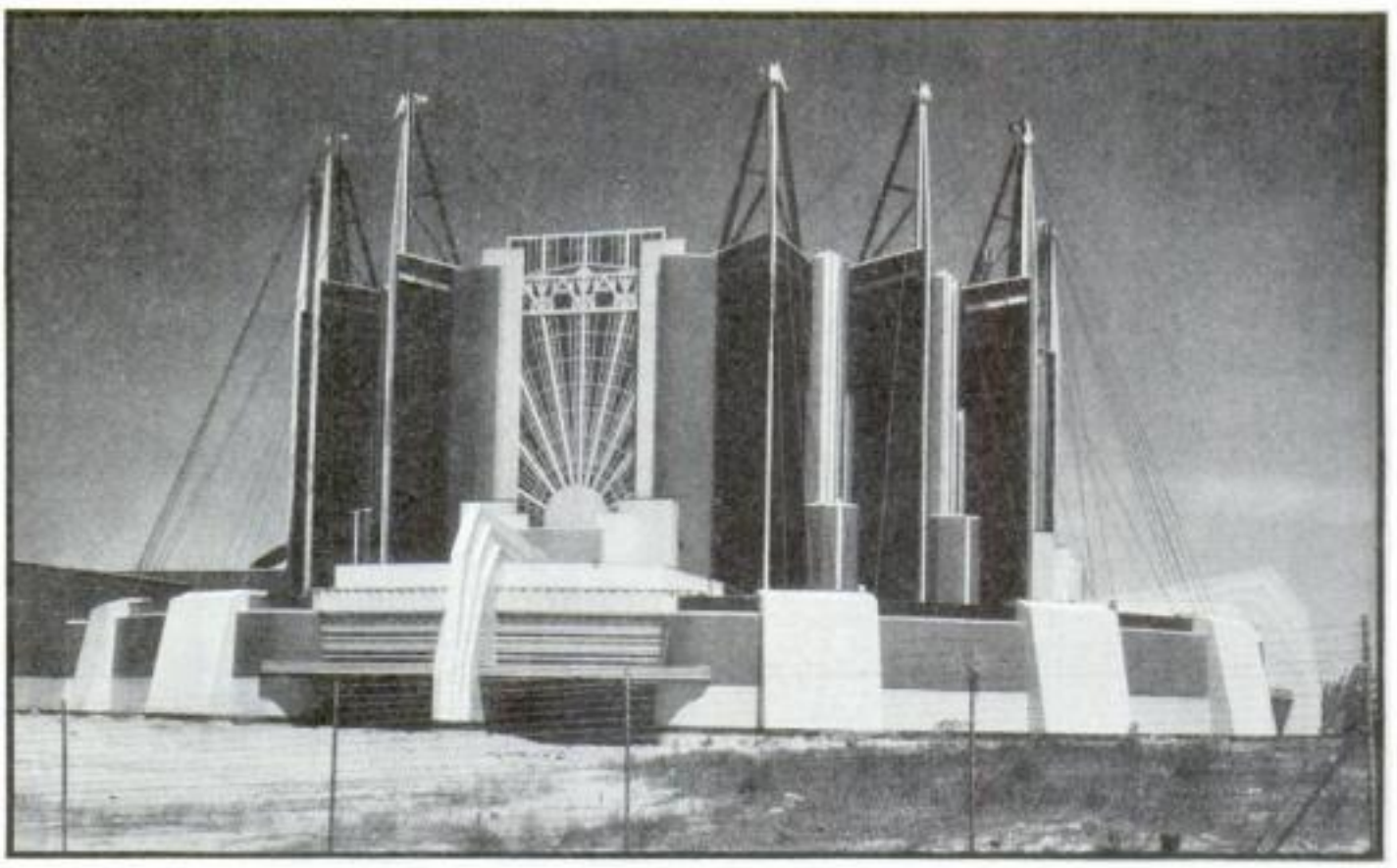
This rooster has been hypnotized by being held gently in the position shown. Usually the trance lasts for about a minute. Chickens can also be put to sleep by swinging.



Snakes are "charmed"—that is, put into a hypnotic trance—by holding them firmly on their backs. Once in this sleep the snake will lie quiet for some time. It is likely that this is not a true hypnotic trance but is a form of muscular paralysis.

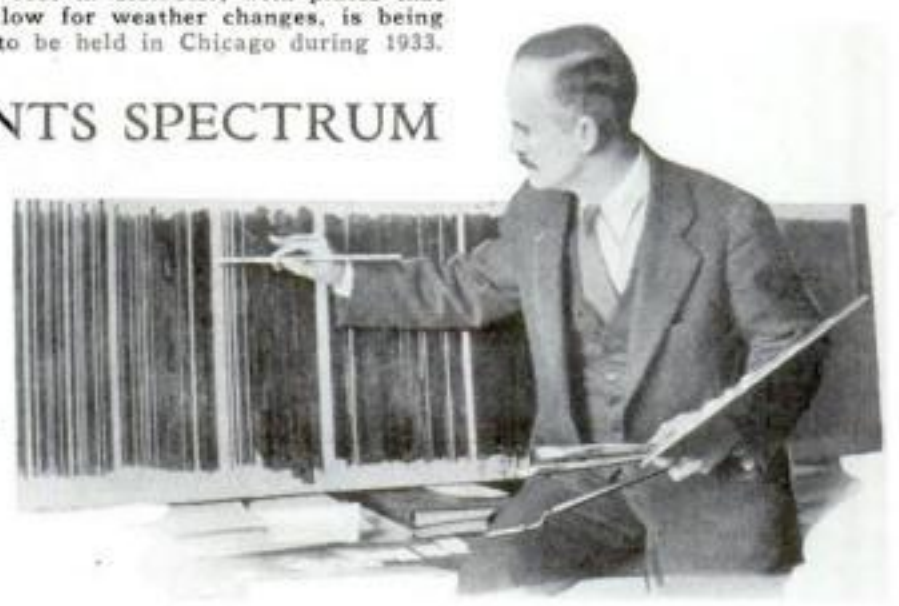
"Breathing Dome" for World Fair Built Like Suspension Bridge

SUSPENSION bridge construction is applied to architecture, probably for the first time, in an unusual "breathing dome" for the Travel and Transport Building—one of the structures that is being rushed to completion for Chicago's World's Fair in 1933. The dome is made up of plates that slide over each other so that it can expand or contract with weather changes. The photograph at the right shows the striking modernistic lines of this unusual dome, 200 feet in diameter and 125 feet high. As there are no upright pillars or beams to support this dome, the space beneath it, over 600 feet in circumference, will be entirely unobstructed, making it one of the few buildings in the world with such a large open space.



This "breathing dome," 200 feet in diameter, with plates that slide over each other to allow for weather changes, is being built for the World's Fair to be held in Chicago during 1933.

ARTIST PAINTS SPECTRUM

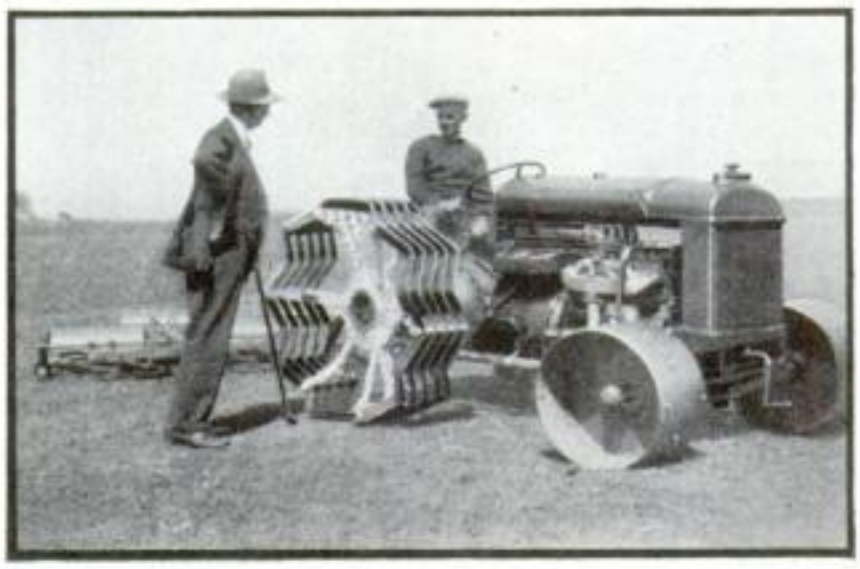


CHARLES BITTINGER, noted artist, whose canvases have been exhibited in the famous Paris Salon and in numerous cities of the United States, turned his talent to an unusual task the other day. The photograph shows him in a Washington, D. C., laboratory of the United States Bureau of Standards, engaged in painting the spectrum of the chemical element rhenium. This is the band of colors produced when a small quantity of the element is heated to incandescence and its light broken up by a prism, giving a rainbowlike effect. The vertical lines that streak this band, each of a different hue, are characteristic of that particular element. Rhenium was first discovered in Germany a few years ago, and is one of the ninety-two ingredients of the earth, or elements, described on page thirty-five of this issue. Another new element, masurium, was found at the same time. These were the last discovered abroad. American chemists found Illinium in 1926, Ekacasium in 1930, and Eka-Iodine, the only remaining missing one, this year.

LAMP SHOWS OPERATION OF GRAVITY CONVEYOR

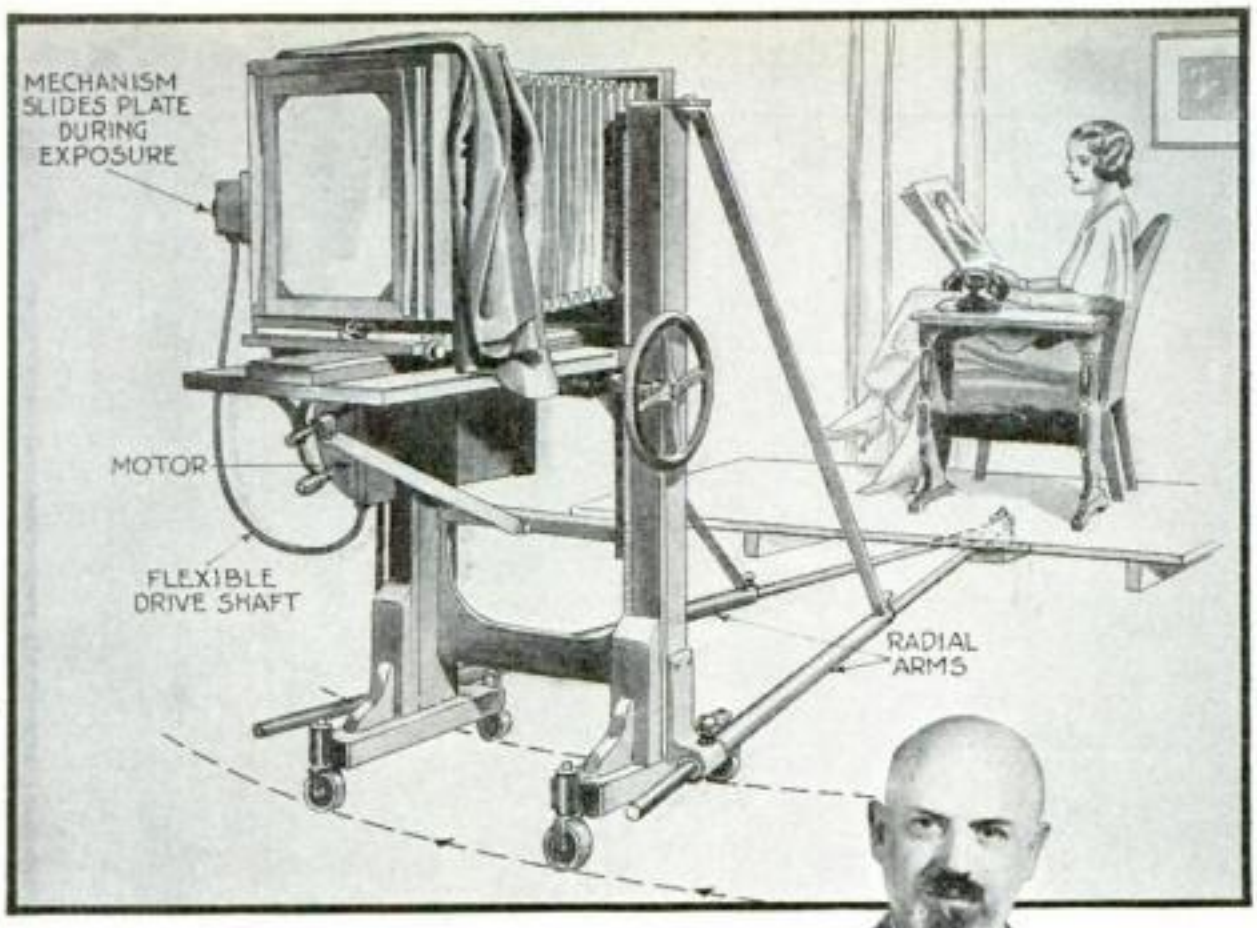
A SHOWROOM that advertises its wares in unusual ways has been established by a New York City firm manufacturing systems of conveyors. Seats and backs of each chair are samples of belting. The top of a center table rolls back to reveal a standard section of a roller-type conveyor. A small pneumatic mail carrier serves as a humidor for cigars, while cigarette smokers may choose their favorite brands from a set of cash-carrying tubes, fashioned into cigarette boxes. Most striking fixture of all is the floor lamp which stands beside the executive's desk. A working model of a spiral gravity conveyor encircles its shaft, giving it a modernistic appearance and enabling the sales engineer to give a demonstration in his office.

TRACTOR'S WAVE WHEEL EASY ON TURF



The rear wheel on this tractor is really round. It is built of steel rings that grip the turf of a golf fairway but don't mar it.

THOUGH they appear to be crinkled, the odd rear wheels of this tractor are actually round when viewed squarely from the side. They are an English invention, and enable a tractor to pull heavy rollers over a golf course without marring the fairway. The tread of each wheel is a series of wavy steel rings. They grip firmly on a grassy surface, but if one of them strikes a stone the wheel slips and cushions the engine.



MOVING CAMERA TAKES THREE-WAY PICTURE

ONE of these days when you call to have your portrait made, the photographer may ask you whether you wish to be taken in three dimensions or just plain flat. A new process developed by Dr. C. W. Kanolt of New York City produces a transparent picture—or a print on paper—in which objects seem to have actual depth. At present it is being used for making advertising signs, and Dr. Kanolt plans to develop it for portrait and general photography as well. A special camera is used to make a "depthograph," as the new-style picture is called. The person being photographed sits on a raised platform about which the camera swings on a pivoted bar in a curved path. During exposure, a motor moves the camera around the object and at the same time the plate moves sideways behind a ruled screen. The resulting print is a blur until it is mounted behind a viewing screen similar to that used in taking the picture. Then the objects in it suddenly seem to come to life and leap out at the observer in their true form and perspective.

At top, drawing shows the operation of depth camera as it swings around person being photographed. Above, Dr. C. W. Kanolt with a picture made by his apparatus.

USE DUMMY BIG GUN AS TARGET FOR PLANES

AN ENORMOUS wooden dummy, representing a big gun, was used as the target for aerial bombers at Hendon, England, during recent airplane maneuvers of the Royal Air Force. Theoretically, it was put out of business by the attacking planes. The size of the unusual mimic fieldpiece may be gaged by the workmen seen erecting it, in the photograph shown above.

FLEXIBLE RAILWAY TIES

FLEXIBLE railway ties recently were announced as the discovery of a German inventor. They are nearly oval in cross section and are open at the bottom so they give to the weight of trains. Their open centers are filled with ballast. Steel plates keep them from slipping.

FLASHLIGHT FITS WRIST

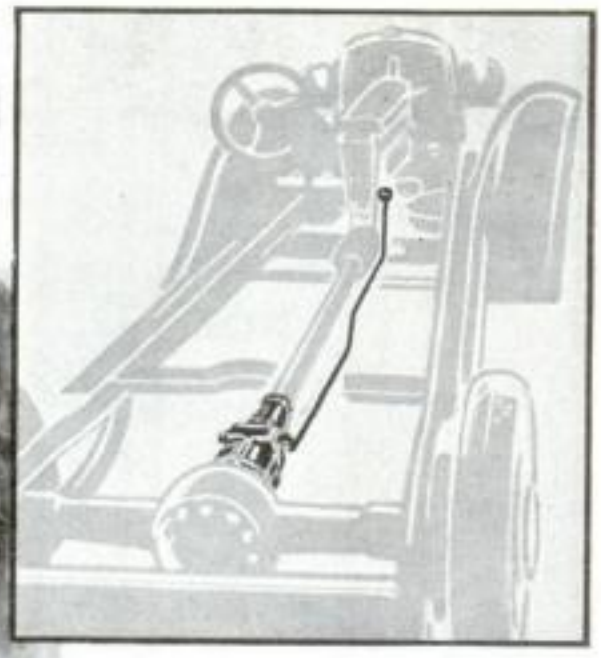
INGENIOUSLY versatile is a new "bomb" flashlight for householders and campers. It stands on its own base, hangs from the wrist or a hook, or slips in the pocket. A milled ring on its face focuses the beam, and a three-way switch sets it for "steady," "signaling," or "off."

TRUCK SPEEDS ELECTRIC SURVEY FOR OIL

A NEW idea in electrical prospecting for oil deposits recently has been given a trial in some parts of New Mexico. A light motor truck, fitted with large wire reels and an electric generating set, arriving in a region where there is thought to be a possibility of oil, strings two miles of wire over the ground. The earth's resistance to electric current from one of the wires is measured, giving a clue to possible stores of oil. Wire is laid down in two lines, one of which is the power line, while the other is the resistance measuring circuit. The lines are connected to electrodes. Oil is likely to be found at the crest of "high spots," or waves into which subterranean layers of the earth's crust may be formed. The resistance of such spots is different from that of the surrounding earth. Consequently an electric survey will show whether such oil bearing spots are near.

NEW FREE-WHEELER FOR LIGHT CARS

This lever beside the driver's seat releases the free-wheeler when motor is used as brake.



View of chassis showing how the special free-wheeling device disengages drive shaft so car can coast.

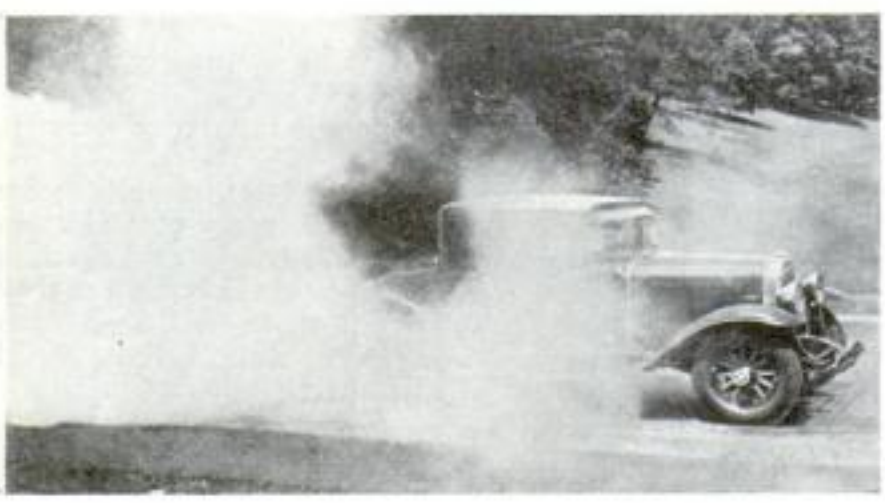
A NEW free-wheeling device with which two popular makes of light cars can be equipped, enables their drivers to enjoy the benefits of this coaster-brake for autos. When a car rolls downhill and the speed of its wheels exceeds the speed of its engine, if the driver's foot is off the throttle, the free-wheeler automatically disengages the drive shaft, permitting the car to coast. If the hill is so steep that the braking effect of the engine's compression is needed to hold it back, a lever beside the driver's seat throws the free-wheeler out of operation. Then the car becomes an ordinary machine, with a direct connection between its driving wheels and engine as long as the clutch is not disengaged by the clutch pedal being depressed by the foot.

SPRAY NOZZLES CLAMP TO SIDE OF HOSE

A STANDARD length of garden hose becomes a lawn sprayer with the addition of one or more clamp-on spray nozzles, devised by an Adler Springs, Calif., hotel man. The hose is punctured at any desired point and a nozzle attached. A pair of screws draw it firmly in place. Then the hose is laid across the lawn and the water turned on. The result is an economical sprayer with any number of nozzles.

EARTHQUAKE HOLES PUTT FOR ENGLISH GOLFER

A SLIGHT earthquake felt the other day at Manchester, England, spoiled the day for two golfers. One of them had missed holing his putt by a narrow margin, when the earth tremors tumbled his ball into the cup. He claimed the hole, but his opponent would not allow it. So the match broke up while the players wrote to St. Andrews for a ruling to cover the strange occurrence.



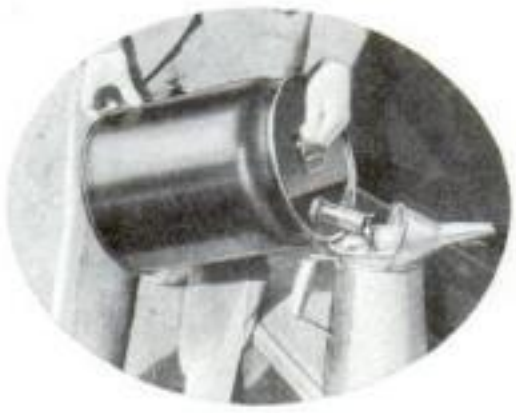
SMOKE SCREEN FOR CAR

GOVERNMENT agents in Cincinnati the other day captured a bootlegger's automobile with a smoke screen. A device beneath the dashboard enabled the driver to throw out a white haze that hid it from armed pursuers. According to W. C. Barcus, U. S. Department of Justice special investigator who is demonstrating the car's smoke screen in this photograph, a mixture was used similar to that employed by Army aviators.

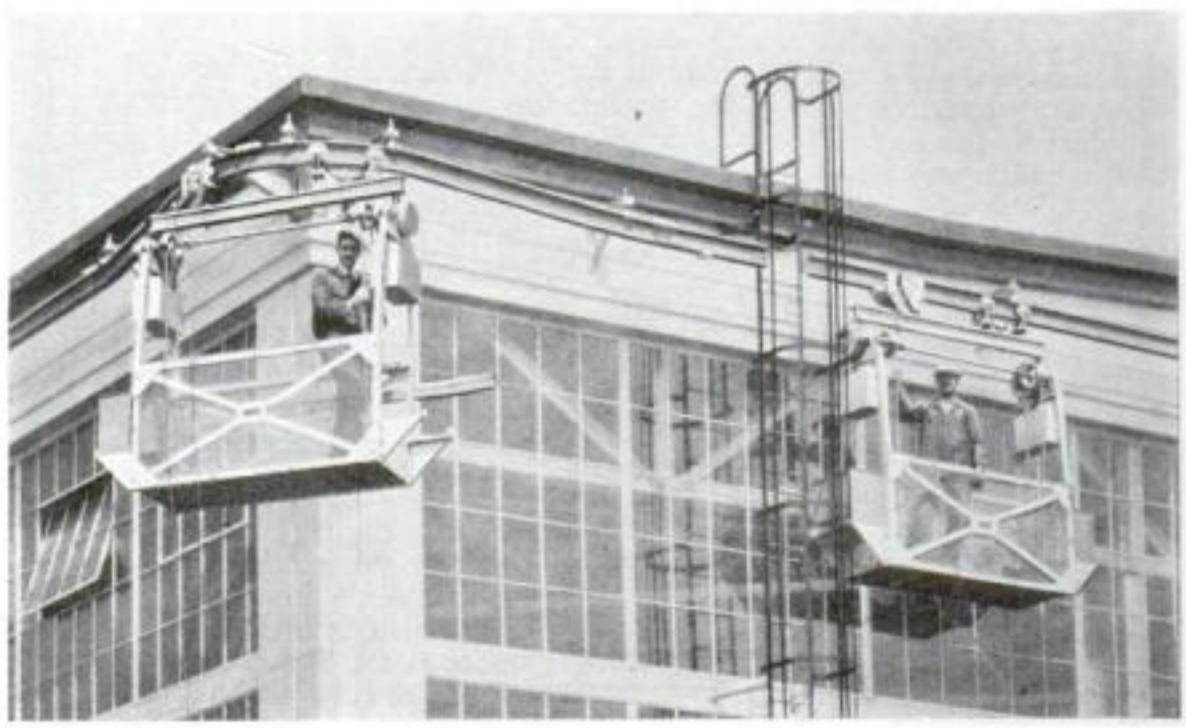
WINDOW WASHERS USE TROLLEY ON BIG JOB

WINDOW washers use a trolley to help them polish the 30,000 panes of glass in a Pittsfield, Mass., building. The miniature trolley cars are propelled by hand, and travel on an overhead rail around the outside of the structure. They may be raised or lowered on chains. Each car carries hot and cold water.

TELESCOPE SPOUT ON NEW OIL CAN

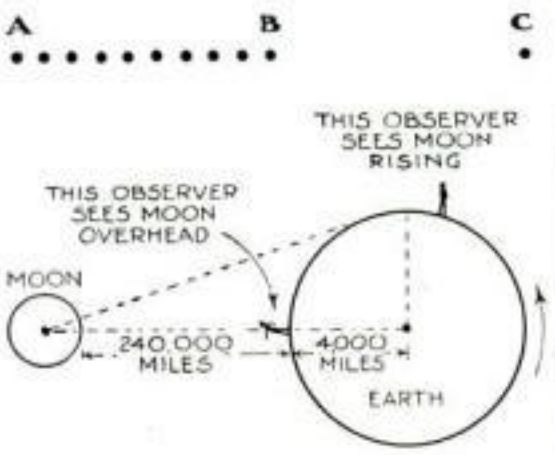


A NEW paint and oil container recently put on the market by a Milwaukee, Wis., manufacturer, has a spout that slides in and out. During shipment, the telescoping spout is pushed down into the container. When in use, the spout, which tilts at the proper angle for pouring, is pulled out. According to the manufacturer, this feature does away with spilling, air-binding, and gushing.



Working in a trolley car suspended from a rail on the outside of the big building, window washers speed their task of polishing the 30,000 panes. The cars can be raised or lowered.

Five Minutes of ASTRONOMY



WHY NEW-RISEN MOON APPEARS GIGANTIC

THE washtub size of the moon as it appears above the eastern horizon is explained by this simple optical illusion:

Take two strips of black paper and cover the type matter above and below the line of dots from A to B. Then decide which distance seems longer—A to B or B to C, judging entirely by the eye and using nothing with which to measure the relative distances.

They are actually equal; measure them and see. The line from A to B seems to the eye to be longer because it is filled with dots, while the line from B to C crosses empty paper. The distance between two points always seems longer to the eye if there are many intervening objects.

For the same reason, the moon on the horizon seems to be more distant than when it is overhead because the eye, in looking toward the horizon, takes in so many things on the way—trees, houses, hills, and so on.

The mind knows, of course, that the moon is really the same size whether in the zenith or just rising. But in spite of this, the illusion of greater distance to the horizon is so convincing to the eye that the mind unconsciously admits that the moon *must* be larger in order to appear like the same object it sees at the top of the sky, and as a result the brain back of the eye actually *sees* it larger.

To prove that the eye fools the mind in this way, roll up a narrow tube of paper about ten inches long and look through it at the washtub moon. It will instantly shrink to the size you see it when it is sailing overhead, for the tube cuts off the trees and hills that cause the illusion.

The astronomical facts, shown in the diagram, prove that the moon should really appear one-sixtieth larger when straight overhead, because the observer is then nearer to it by 4,000 miles, which is half the earth's diameter and one-sixtieth the distance to the moon.

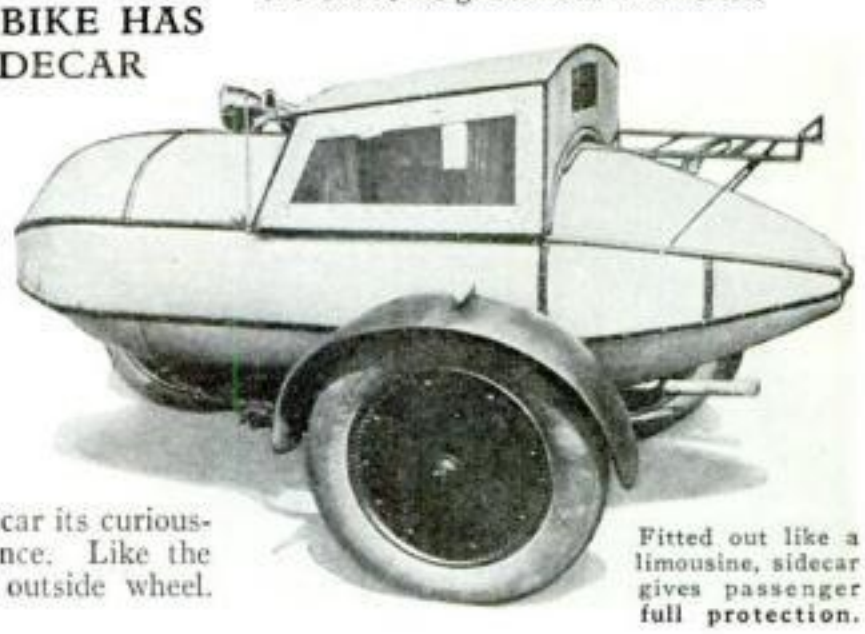
Rock drills working at full speed. Note one at right kept free of dust by dust catcher.

DUST CATCHER PROTECTS ROCK DRILLER'S LUNGS

UNTIL a few weeks ago, the workman who turned his chattering rock drill against a cliff was likely to be committing slow suicide. Sharp-edged, microscopic particles of rock rose in clouds of dust from his drill point and attacked his lungs, in the often-fatal disease known as "silicosis." Therefore health officials watched eagerly while drillers tested, on a New York construction job, a new dust catcher for rock drills invented by George S. Kelly, New York City engineer. They saw a suction hose, ending in a doughnut shaped hood encircling the drill, suck away all dust. Behind the scenes were metal tanks where water sprays caught the dust and disposed of it harmlessly. One such installation handles the dust of sixty drills. So successful was the device that New York State's Department of Labor proposes to make compulsory its use by all rock drillers. Its installation imposes no hardship on the contractor, as tests show drills can now be operated at twice the former speed without covering the entire neighborhood with dust.

GERMAN MOTORBIKE HAS LIMOUSINE SIDECAR

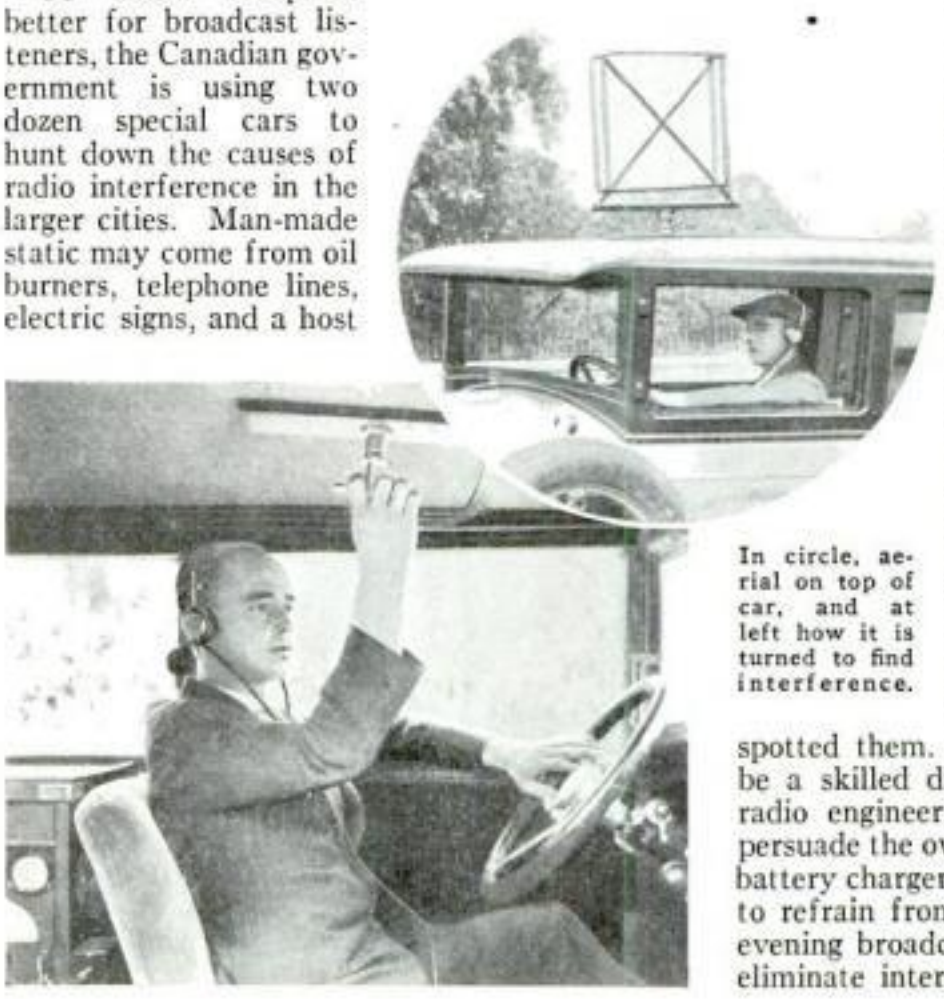
THE passenger who rides beside the motorcyclist gets limousine comfort in a novel sidecar that made its appearance not long ago on Berlin streets. Its buglike body carries a weatherproof top with wide windows. A windshield protects the occupant from the buffeting of the weather and streamlining gives the car its curiously unconventional appearance. Like the usual sidecar, it has one outside wheel.



Fitted out like a limousine, sidecar gives passenger full protection.

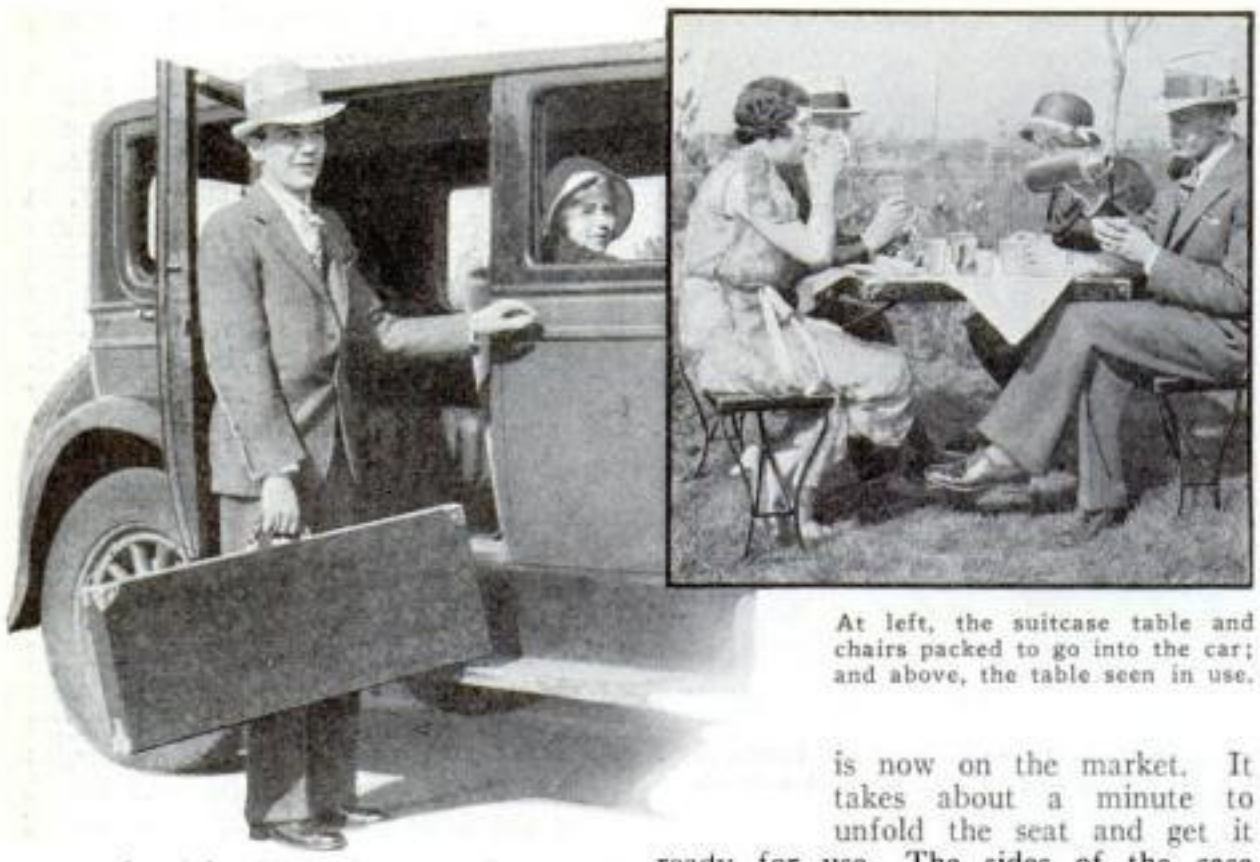
SLEUTHS HUNT RADIO INTERFERENCE

TO MAKE reception better for broadcast listeners, the Canadian government is using two dozen special cars to hunt down the causes of radio interference in the larger cities. Man-made static may come from oil burners, telephone lines, electric signs, and a host of other sources. The driver of each car listens with the aid of headphones for any extraneous hum or buzz. He can turn a loop aerial on the car roof in any direction to trace the disturbances picked up by his super-sensitive receiver. Many of the sources of interference, such as defective insulators on power lines and occasionally a piece of hay wire caught on transmission wires, can be removed after the interference man has spotted them. The inspector must be a skilled diplomat as well as a radio engineer, for he must often persuade the owner of a troublesome battery charger or an X-ray machine to refrain from using it during the evening broadcast hours or fix it to eliminate interference.



In circle, aerial on top of car, and at left how it is turned to find interference.

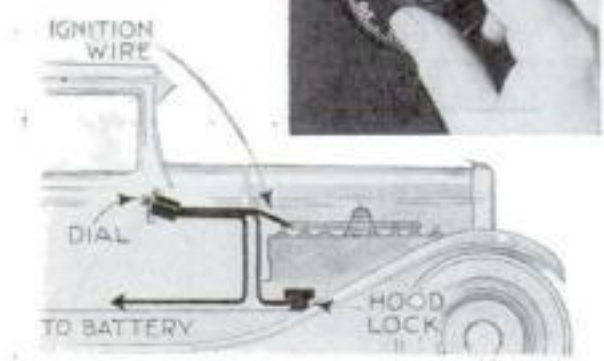
TABLE AND CHAIRS JOIN IN ONE UNIT



At left, the suitcase table and chairs packed to go into the car; and above, the table seen in use.

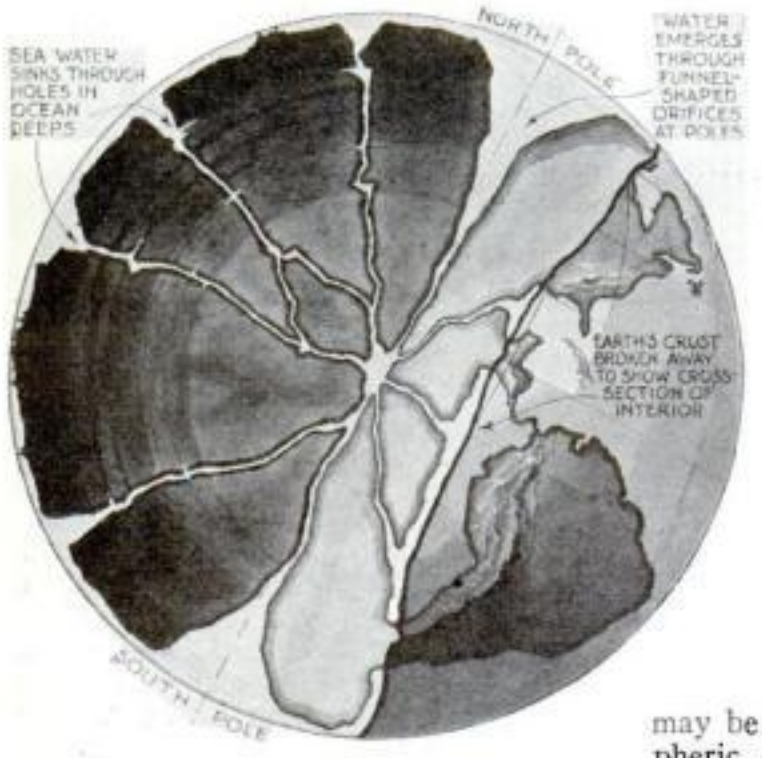
For camping and for outings, a table and seats, combined in one folding unit that resembles a suit case when collapsed, as illustrated in the photograph above, is now on the market. It takes about a minute to unfold the seat and get it ready for use. The sides of the case become the top of the table, the benches are swung out from inside, and there results a comfortable dining table and seats with room for four persons.

This combination lock for cars locks ignition and hood as shown in the diagram given below.



DIAL LOCK FOR CARS

Auto thieves who steal machines equipped with a new combination lock will have to be trained bank robbers, according to the inventor. The lock is attached to the dashboard. Similar in appearance to the dials used on safes, it operates electrically through the car's battery. On leaving the car, the driver pushes in the knob and gives the dial a twirl. This locks the ignition and the hood, which are unlocked by turning the dial. When the third number of the combination is reached, the center knob pulls out and the car unlocked.

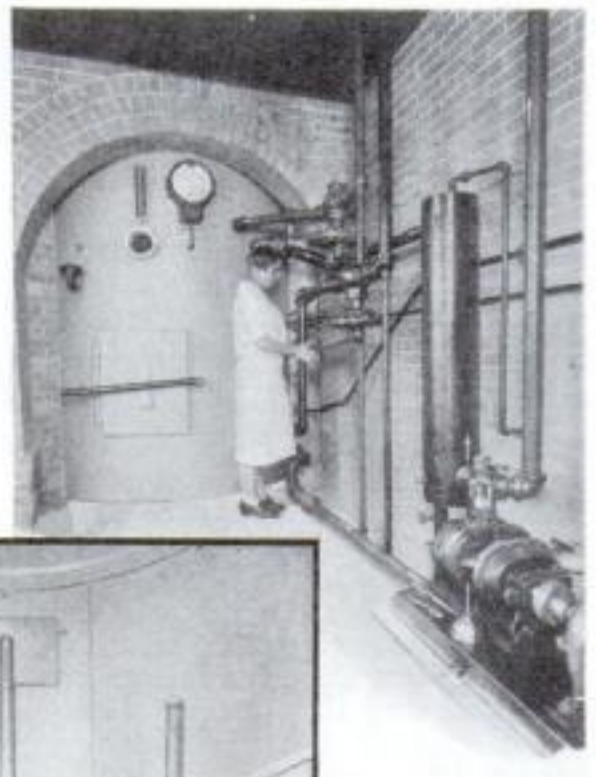


DOES WATER RUSH FROM EARTH'S INTERIOR?

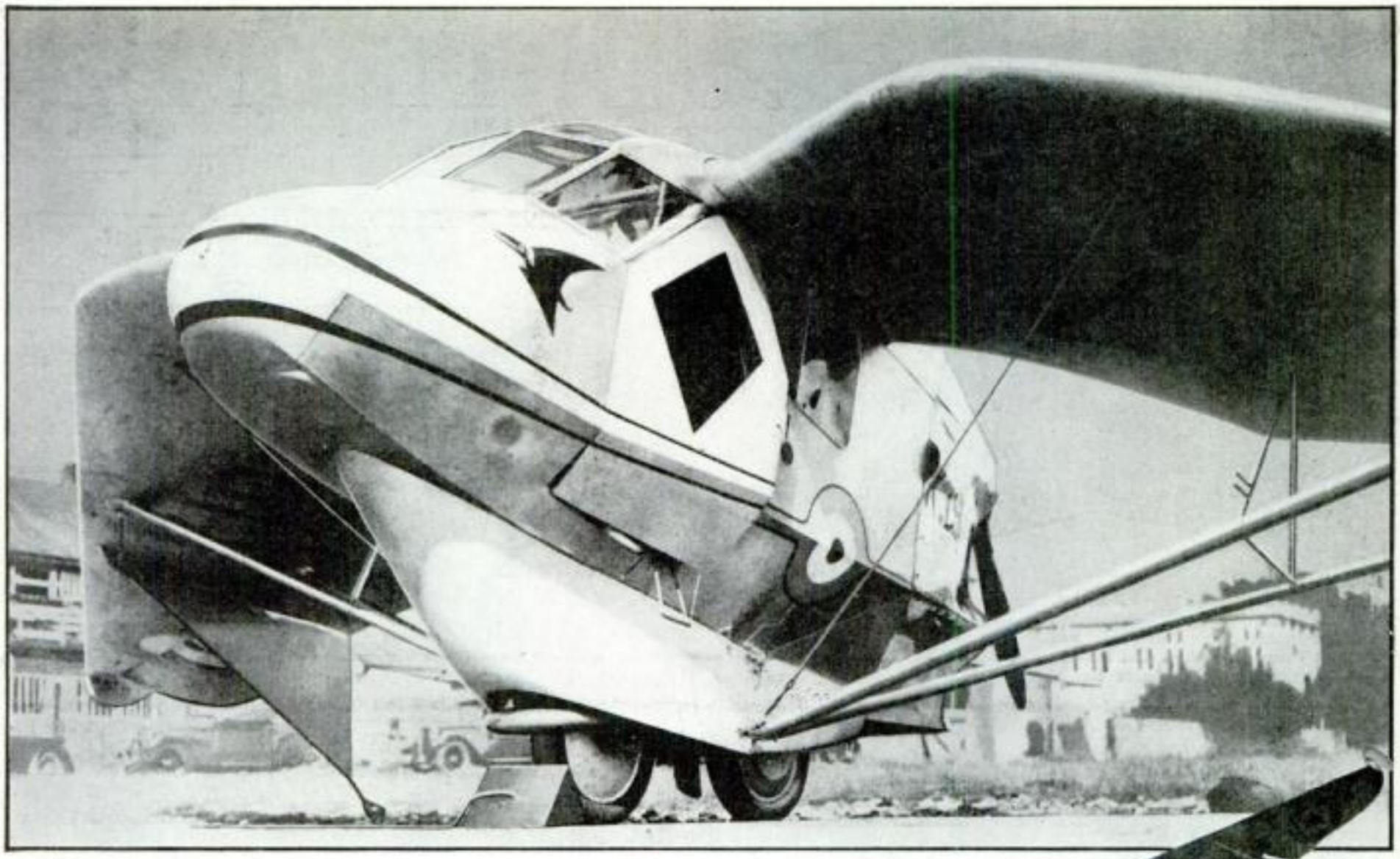
If the Arctic-bound submarine *Nautilus* succeeds in reaching its undersea goal at the North Pole, its depth finders will have a chance to test a startling theory of the earth's interior. According to Dr. Richard O. Meents, former professor of geology at Southern Methodist University, Dallas, Texas, soundings should reveal a great bottomless hole of funnel shape beneath the Pole. From this and a similar hole at the South Pole, water continually gushes, according to a theory Dr. Meents has just made public. Huge conduits in the earth's interior, he believes, feed these openings, and are in turn fed by leaks in the ocean deeps of the Atlantic and Pacific, thus maintaining a constant circulatory system. This is the newest of many strange ideas of the earth's interior that have been proposed by imaginative scientists.

USE PRESSURE TANK IN COOKING TEST

The best way to bake a cake on a mountain peak or to brown a pan of biscuits at the seashore is being studied at the State Agricultural College of Colorado at Fort Collins. Within an "altitude room," the first of its kind in the world, experiments are carried on to determine the proper ingredients to be used for high and low altitude baking. Not only does water boil at a lower temperature on the mountain top, but other cooking processes are affected by change of air pressure with elevation. The altitude room is a steel tank, nine feet high, with a diameter of seven feet. The air pressure may be raised or lowered so that atmospheric pressures of elevations varying from the highest snow-capped peak in Colorado to the below sea level of Death Valley can be obtained. A rotary blower driven by a motor forces fresh air into the room and carries the old air away. The person who is doing the experimental cooking is locked in the tank, while an assistant remains outside to watch the dials and keep the machinery working properly. The room and apparatus were built under the direction of the mechanical engineering department of the college. A similar tank is now being used in Washington, D. C., by the United States Bureau of Standards for testing the effect of atmospheric pressure on aviators and power plants for aircraft under conditions similar to those existing at great altitudes. The two tanks of course vary in construction.



At left, interior of Colorado's altitude room in which cooking tests are being made. Above, outside of room showing dials that work machinery.



NEW PLANE LOOKS LIKE GIANT BAT

LIKE an aircraft designer's most fantastic dream is England's new "flying bat." Its swept-back wings and extraordinary fuselage gave it an impressive resemblance to a bat in flight when it soared recently over the Royal Air Force station at Farnborough, England. The V-shaped wing design is said to give unusual stability in the air. A single pusher propeller drives the freak airplane. Its landing wheels are in tandem instead of side by side, and wing skids help support the craft on the ground. It is an experimental development of the pterodactyl type of plane demonstrated before in England, named after a prehistoric winged monster. An inclosed cabin has been added in the new design.

Above, a close-up of England's new "flying bat" plane and at left, the plane in the air.

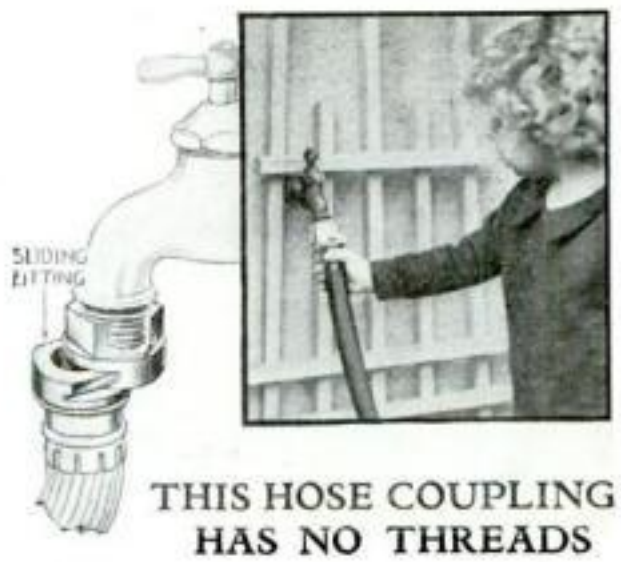
MATCHES FAIL TO LIGHT NEW FUEL FOR PLANE

LIGHTED matches failed to ignite a fuel as powerful as high-test gasoline in a demonstration made recently by research engineers at Langley Field, Va. This new aviation gas promises to eliminate fire hazard in crashes. It is a yellowish fuel containing less sulphur than ordinary gasoline and results from a new refining method developed by a leading American oil company. Its high flash point is reported to make it as safe as Diesel oil.

SHRINKING GLUE CHIPS GLASS

FROSTED glass for office partitions and doors is now made by using the amazing pulling power of shrinking glue. First a sheet of glass as smooth and clear as a window pane is lightly sand-blasted. Then a strong adhesive, such as animal glue, is applied with a brush. The glue sinks into the tiny depressions in the glass. As it dries, it shrinks. So great is the glue's tenacity that it pulls off chips of glass in an irregular frosted pattern that diffuses the light but does not leave the glass transparent. When the glue and chips are washed off, the pane is ready for the market.

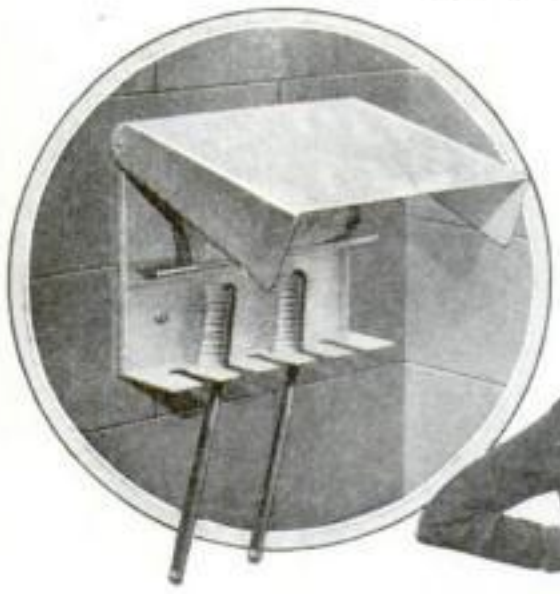
At upper left, a coat of glue is applied to clear glass. At left, a pane of glass as it looks after it is chipped by shrinking glue.



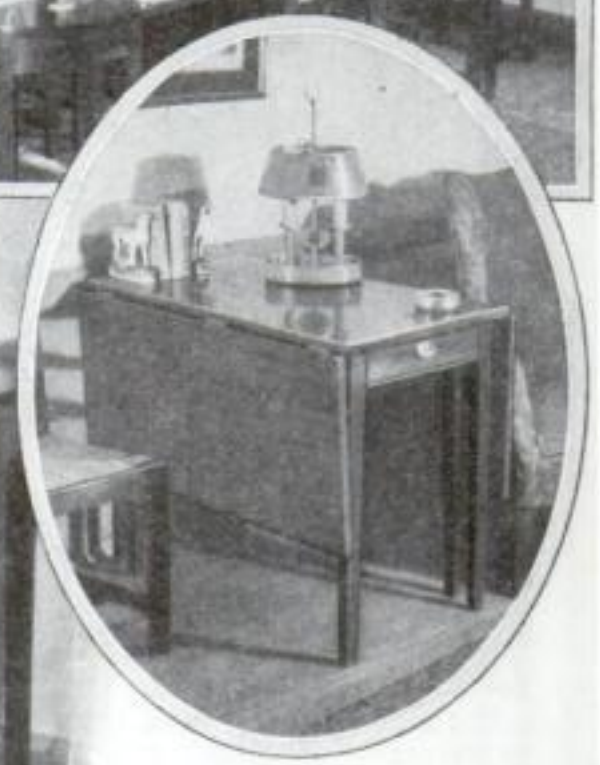
THIS HOSE COUPLING HAS NO THREADS

SOMETHING new for your garden hose is a coupling that has no threads and connects easily. Placed on the market recently by a Berkeley, Calif., manufacturer, it has a fitting that screws over the end of the faucet and is left there. In this is a slotted outer face into which the coupling on the hose slides. This makes a tight joint without use of gaskets or washers, often lost or mislaid.

New Tools That Make

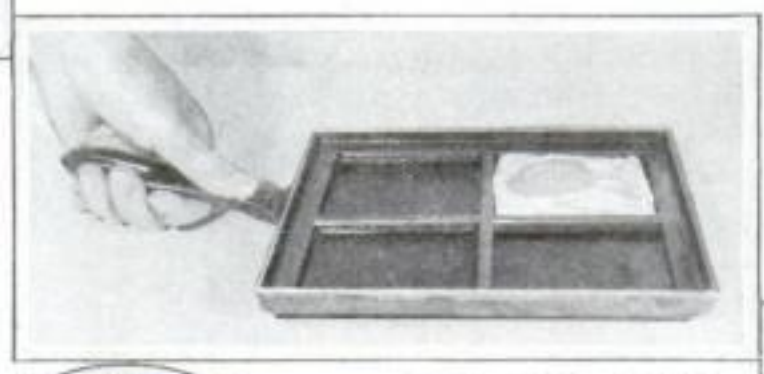


GUARD THE TOOTHBRUSH. This metal rack, with pivoted cover, for the bathroom wall is designed to hold toothbrushes and paste and protect them from dust and insects found in even the cleanest home.



THIS TABLE IS VERSATILE. At top, left, and in oval are three views of the same table set. At left it is a console table, thirty-six inches wide; at top it is a dining table, ninety-seven inches long; and in oval it is a reading table. Center tables between console table ends make it possible to extend to even larger size for banquet use.

ROLL CLOTHES CLEAN. Wearing apparel placed in this can, which contains a special fluid, is cleaned by rolling the can.



SQUARE UP THE EGGS. With the pan shown at left, eggs can be cooked square in shape and thus made to conform to the shape of bread for sandwiches. Eggs are kept separate by the partitions.

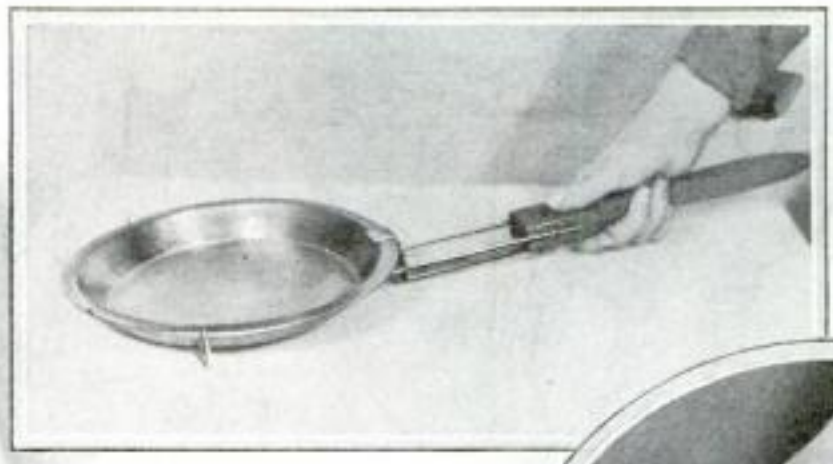
COFFEE CAN ALWAYS CLOSED. Only to refill this coffee can, is it ever opened. Tilting can fills the measure, which holds enough for one cup.

WHY SPILL MILK? Taking the top off the ordinary milk bottle is always a chance as the milk may come out suddenly and spatter your dress. The cap at left is removed with a twist and can then be refitted to protect the contents.

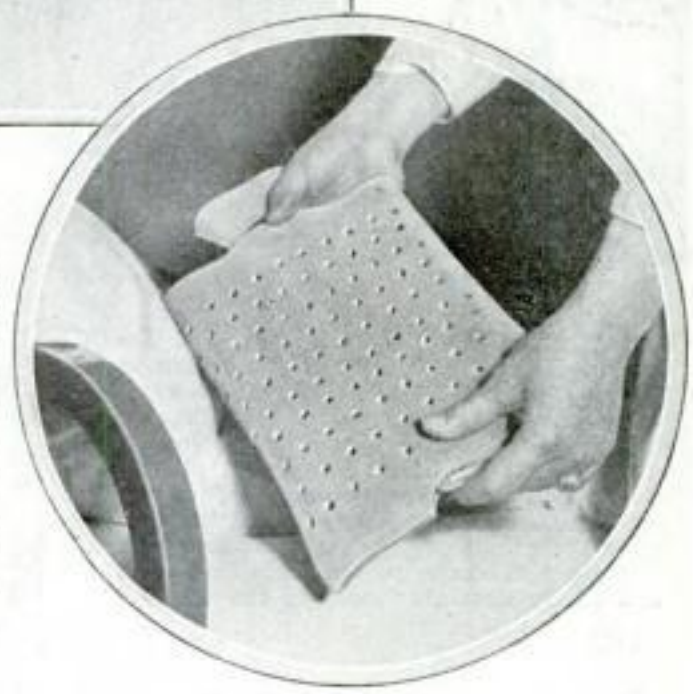
SCRUBS THE WALLS. The wall cleaner shown at right uses no water but works on the principle of an eraser rubbing the dirt off and absorbing it so there is no muss caused by cleaning.

Your Home Tasks Easy

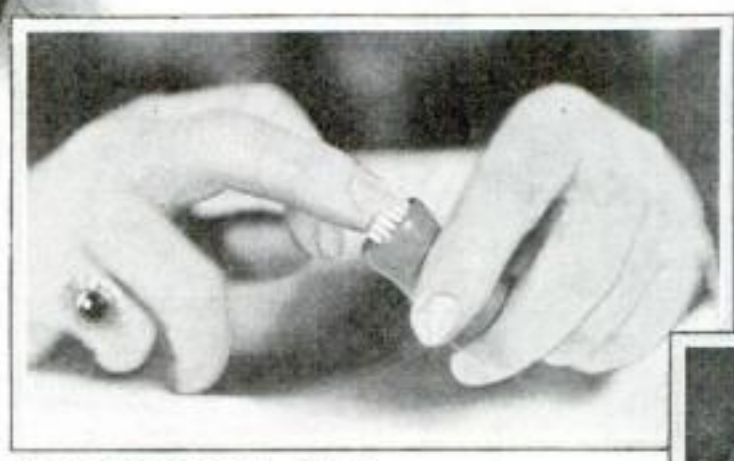
PORTABLE STEAMER. You can now renovate your own furniture by using a portable steamer and refinisher as seen at the left. The apparatus plugs into the house current. It consists of a boiler in which water is heated electrically, and a superheating tube through which the steam is released.



HOLDS THE PAN. Pies can be lifted from the oven by means of the long handled lifter seen at left with no fear of dropping them, as the lip and support fit pan snugly, and are designed to hold securely.

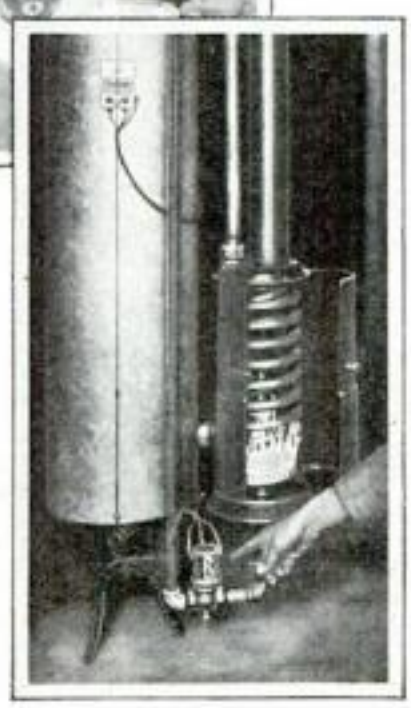


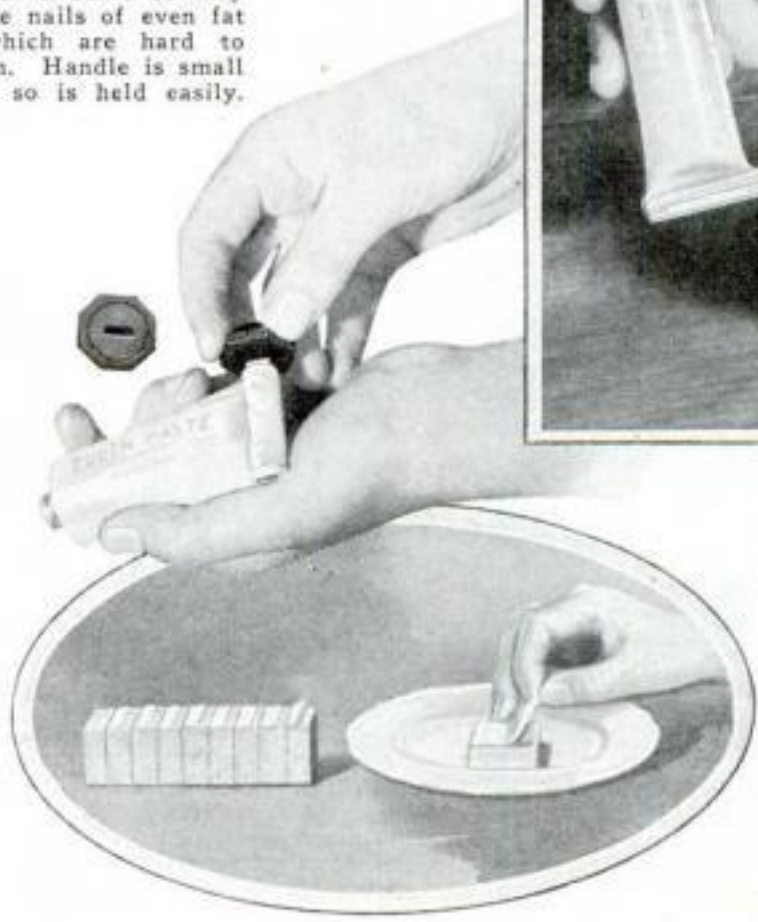
DRESSED UP HOT WATER BOTTLE. Tailored jackets have been designed for the hot water bottle to take the place of towels. The one shown above is of perforated rubber sponge and is expected to temper the heat and act as an insulator. If moist heat is wanted it can be dipped in hot water, wrung out, and then placed over the bottle.



FITS THE NAILS. Bristles in this nail brush are set in the form of a curve so they will fit the nails of even fat fingers, which are hard to wash clean. Handle is small in center, so is held easily.

HOT WATER. The automatic device shown at right turns the gas on to heat water at the pressure of a kitchen or bathroom button as seen in picture above. It can be turned off with another button or it will shut itself off when the water in the tank reaches a predetermined temperature. It is electrically operated and is said to be economical and easily attached to the heater.





ROLLING PASTE TUBE. A key is designed to roll tube of toothpaste or shaving cream. At left, top of tube is slotted to fit slightly extended clip on the bottom of tube.

READY SLICED BUTTER. No further worry about getting butter ready if a new slicing machine does what its maker claims. It is built to slice butter and place paraffin paper between slices.

Secrets *of* Nature Sought *on*

HEADING A GREAT EXPEDITION. Into the remote wilderness of Turkestan in the southern part of Central Asia, this caravan of camels bearing provisions is headed with the Alai-Pamir Mountain region as the destination. There on a wild plateau surrounded by grinding glaciers, distinguished German and Russian scientists will pitch their tents prepared for thrilling work and sport and adventure on this far famed and wildly desolate "Roof of the World."

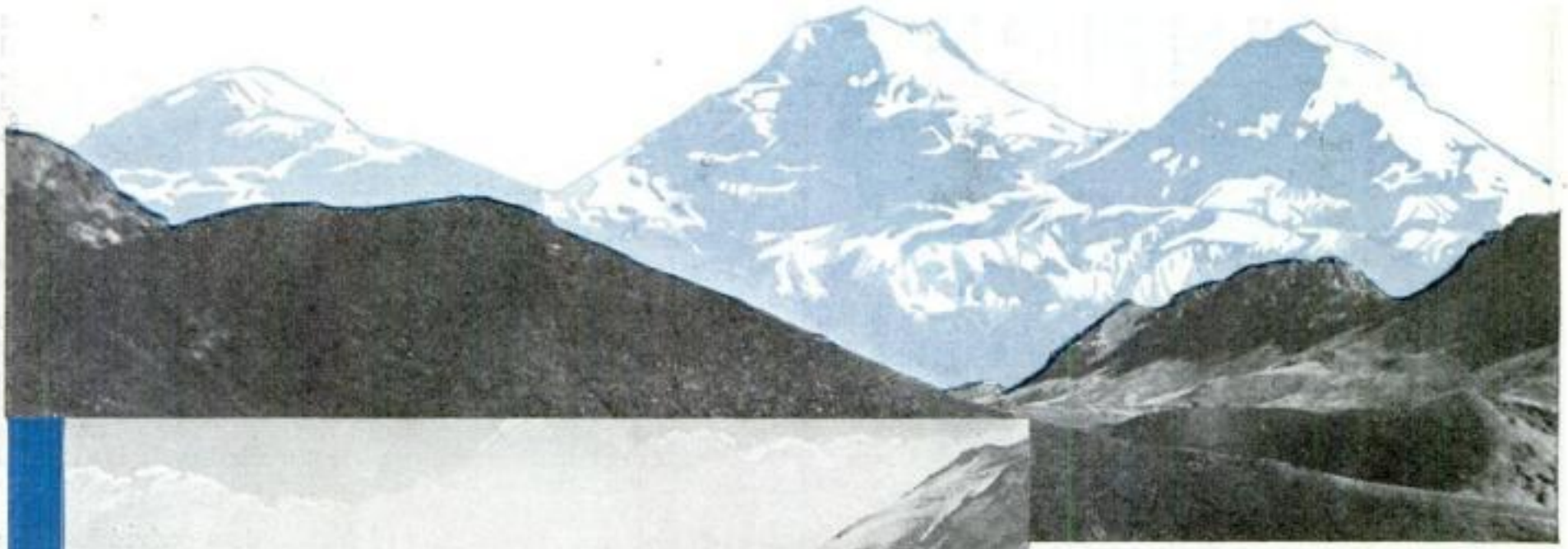
ALL OUT FOR HIGH ADVENTURE. Here are the members of the international scientific party that will invade the Pamir region for sport and scientific exploration. The Germans are led by Professor Willi Rickmers, authority on Turkestan exploration. The Russians are under Dr. D. J. Dscherbakow. There are also five Alpine climbers.

RIDE HIM! Kirghiz children take early to horseback riding and soon learn the tricks of their elders. The Kara-Kirghiz tribes that inhabit the Pamir region are of Turkish blood with Mongol traits. There are only 340,000 of them with tribal "manaps" that enjoy unlimited authority ruling them.

ON THE WORLD'S ROOF. Surrounded by a desolate waste, the members of the international scientific expedition stand on one of the highest plateaus in the world. This scene is characteristic of the lonely wilderness into which these men are making their way for the purpose of adding to the sum of human knowledge. This region is 280 miles long from north to south and 150 miles wide from east to west at its narrowest part.

SNOWBOUND WASTE. This lone figure seen in the foreground is climbing one of the high mountains in the Pamir region, a district seldom visited by men. It is in settings of this kind that the Pamir expedition will depend for success on its Alpine men.

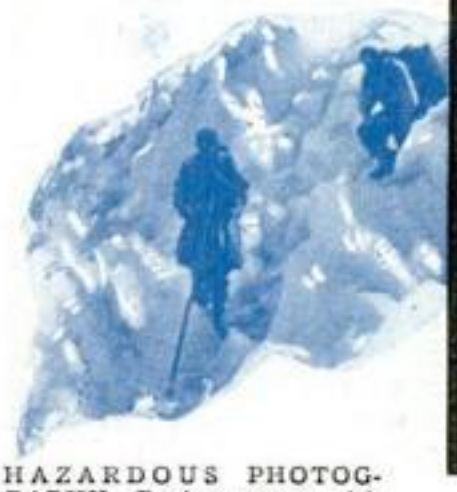
the High Roof *of the* World



GIANTS OF ALL THE WORLD. These snow-capped mountains, flashing in the sun, look down upon the site where the Fedtshenko glacier, said to be the longest in the world, was discovered. The Alai-Pamir range boasts some of the highest known mountain peaks in the world.

SILHOUETTES AGAINST ICE. These three figures are climbing painfully through a flower garden of broken ice in a meadow formed by a glacier, high up toward the roof of the world. This photo suggests some of the natural beauties found by the members of the party invading little-known Pamirs.

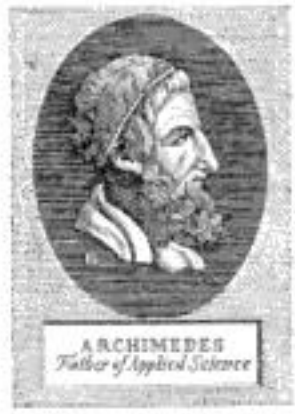
JUST A NATIVE HUT. In the foreground is the pointed roof of a native hut and rising majestically behind it is a great mountain peak. At right is a fetish pole, topped by the head and horns of an animal thought to bring luck.



HAZARDOUS PHOTOGRAPHY. Daring scouts risk their lives in an effort to film this snowy wonderland for the folks back home. Carrying their packs to this altitude is a difficult and tiring task.

A MIGHTY RIVER OF ICE. This remarkable photograph shows one of the vast glaciers that flow slowly and relentlessly down the high valleys of the Alai-Pamir Mountain range. The striking light effect seen here, obtained by making a dark print, brings out vividly the striated character of this glacier. The ice moves only a few feet in the course of a year and bears with it enormous loads of rock and snow packed hard as rock.

POPULAR SCIENCE
MONTHLY



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Naming New Inventions

ON ANOTHER page of this issue, you read of Capt. Richard H. Ranger's pipeless organ. If this revolutionary instrument attains wide popularity, what will it be named? Will it possibly be called the "ranger" after its creator? This thought occurs to us because the "theremin," the latest invention so to be named, is another musical instrument which also produces sound by what may be called radio methods.

Too few of the world's inventors have been honored by having their inventions carry their names. There is the "sandwich," named for the Earl of Sandwich, who didn't invent the delicacy; the "brougham," getting its name from Lord Brougham, who didn't design the carriage; the "raglan," derived from Lord Raglan, who had nothing to do with tailoring the large-sleeved overcoat. Yet, there is no device called an "edison" although Thomas A. Edison, with his more than 1,100 patents, is the greatest inventor of our time.

Only a handful of nouns have been added to the English language by new inventions which carried their inventors' names. One of these is the Zeppelin. This rigid dirigible was invented by Count Ferdinand von Zeppelin, the German engineer who made his first balloon flight in America during the Civil War. Another is the mackintosh, the waterproof garment made possible by the discovery of the Scottish chemist, Charles Macintosh, that two thicknesses of india rubber could be cemented together with naphtha. Another Scotchman, John Loudon McAdam, devised the hard surface highway which carries his name as the macadam road.

Although comparatively few people know it, the shrapnel used in the World War got its name from a British army general, Henry Shrapnel, who invented it.

It is curious to note that implements of war have been more frequently associated with the names of their inventors or makers than other types of devices. The slang term for the giant German gun, the "Big Bertha," during the World War, was derived from the name of the head of the Krupp steel works, Frau Berta Krupp.

The Gatling gun, the ancestor of the modern machine gun, was named for its American inventor, Richard J. Gatling, who also designed a steam plow and invented a steamboat propeller. Other machine guns bearing the names of their inventors include the Maxim, Vickers, Lewis, Browning and Hotchkiss. Other firearms, much in the same way as automobiles, also are known by the same name as those who designed them. Conspicuous examples are the Colt, Winchester, the Mauser, the Lee-Enfield, and the Krag-Jorgensen, which was used by American soldiers in the Spanish-American war.

Compound nouns for discoveries and inventions not infrequently carry the surnames of the scientists who achieved them. The commonest examples are Bessemer steel, resulting from the blast furnace methods of Sir Henry Bessemer; the Bunsen burner, invented by R. W. Bunsen; the Davy lamp, produced by Sir Humphry Davy; the Morris chair, designed by the English poet, William Morris. Similarly, the X-ray was first called the "Roentgen ray" in honor of the scientist, W. K. Roentgen, who accidentally discovered it in 1895.

The Diesel engine, of Dr. Rudolph Diesel, comes in this class, as also does the mansard roof, first incorporated in a house by the French architect, Francois Mansard.

In Hollywood, the Klieg lights of the movie studio carry the name of the two Klieg brothers who invented them.

A few of the words we use in referring to inventions are so familiar we take for granted they are derived from the inventor when actually they are not. The guillotine was the namesake of Dr. Joseph Guillotin, who introduced it into France in 1792 but did not invent it. Although this instrument of execution became most notorious during the French Revolution, it had been a common medieval device for executing people condemned to death.

Similarly, the bowie knife of frontier days derived its name from the famous pioneer Colonel James Bowie, who used such a weapon but probably did not invent it. The Pullman sleeping and parlor car was named after George M. Pullman because he introduced and sponsored the cars and not because he designed them.

In the dictionary you will find a number of verbs that sprang from the surnames of inventors of the past. Probably the best known is "pasteurize," meaning to heat by a particular process in order to retard fermentation. It was derived from the name of the famous French chemist, Louis Pasteur. Almost as well known is "mercerize," to treat fabrics chemically as an aid to dyeing. This process was introduced by an English printer of calicos, John Mercer. "Kyanize" means to protect wood from decay by saturating it with corrosive sublimate and the verb comes from the name of J. H. Kyan, the chemist who invented the process. "Boucherize" is practically synonomous with "kyanize." It comes from a similar process invented by the French chemist, Dr. August Boucherie.

In recent years, there has been a steady decrease noted in the number of inventions named for their creators. Probably this is due to the fact that a larger number of innovations are coming from the laboratories of large corporations than from the workshops of private inventors. Most important inventions today, even if produced by individual geniuses, are bought by large corporations where they are modified and improved before being put on the market.

In the field of electricity, there is a group of scientific terms that represent memorials to several of the great physicists of the past. Among the commonest of these single-word monuments are the watt, a unit of power, named after James Watt, the Scottish inventor of the steam engine; the ampere, a unit of electrical current, derived from the surname of the French electrician, A. M. Ampere; and the volt, a unit of electromotive force, suggested by the name of the pioneer Italian electrician, Alessandro Volta.

But the most unusual case of all is that of George Simon Ohm, the German electrician, who lived in the early part of the nineteenth century. Perhaps because him name was short, it was used not only once but twice. The unit of electrical resistance is the "ohm"; that of the opposite characteristic, electrical conductivity, is the "mho"—Ohm's name backward!

Correcting a Mistake

POPULAR SCIENCE MONTHLY is proud of its reputation for accuracy. Occasionally, though, we make a mistake, and, when we do, we always hasten to correct it in order that you may maintain your confidence in the magazine. In the July issue, in the article on soft drinks, we made two misstatements. We said that the coca leaf contains morphine and that caffein is a narcotic. The truth is, morphine is a derivative of opium which is prepared from the poppy and caffein is a stimulant. Not detected by us until the magazine was off the press, these two errors were passed on to you as facts. Insert this correction in your file, along with our apologies, and so preserve the accuracy of your bound volumes.

Switch Muffles Set

When Phone Is in Use

Lifting phone receiver from hook releases a spring that automatically closes switch and reduces loudspeaker volume.

THE difficulty of telephoning while the radio is filling the room with sound has resulted in the development of ways to turn off the radio automatically while the phone is being used. One way of doing the job was shown in this page several months ago (P. S. M., Dec. '30, p. 83). That method applied, however, only in special cases.

The illustration above shows a new type of switch, recently invented, which is placed under the telephone instrument. When the receiver is lifted off the hook, the reduction in weight allows a spring to move the telephone instrument upward a fraction of an inch, closing a switch. This puts a damper on the operation of the power tubes in the set and so reduces the volume from the loudspeaker.

Connection is made to the set by means of a cord having two special adapters which are applied to the power tubes as they are slipped into the sockets. By this arrangement, the receiver is left in full operation so that the broadcasting immediately goes up to normal volume when the receiver is replaced on the hook at the termination of the phone call.

Measuring Resistances

MODERN radio receivers use a number of fixed resistances of various values ranging from a few hundred ohms to thousands of ohms. In well built receivers, high quality resistance units are fitted and these have a long life. However, when a resistance unit goes bad, the value of the resistance goes way up or else the circuit gives out entirely, resulting in no flow of current at all. Any change in the value of a resistance at any point in the radio circuit upsets the operation of the receiver. In some cases it affects the volume, in others the tone quality.

Whenever a radio receiver develops reception difficulties that can not be traced to a poor tube or a broken antenna or ground wire, a resistance may be defective.

If a milliammeter is available, it is possible to determine the value of a resistance by several different methods. The simplest is to apply a known voltage such as that from a battery, then measure, with the ammeter, the amount of current that flows through the resistance. The value of the resistance in ohms is found by dividing the voltage by the current in amperes.

The diagram at right shows a simple arrangement of the milliammeter circuit that makes it possible to read the value of the resistance in ohms directly from the face of the ammeter. If, for example, the battery has a voltage of 22½ and the fixed resistance a value of 22,500 ohms, short-circuiting the binding posts will cause the needle to swing to the end of the dial of a meter reading to one milliampere. Twenty-two and one half divided by one milliampere (.001 ampere) equals 22,500 ohms.

Any value of resistance connected between the binding posts will cut down the reading of the meter. A resistance of 22,500 ohms would, for example, reduce the current flow by half because it would double the total resistance in the circuit and the needle would, in consequence, swing only halfway.

Any desired range of measurement can be obtained by changing the value of the fixed resistance and of the voltage applied to the circuit and following the formula given in this article.

A B C's of Radio

IT IS difficult to judge the quality of radio apparatus by appearance — true electrical quality has nothing to do with looks. The worst radio tube made may look exactly like the best. The audio transformer which is nothing but a laminated iron core wound with copper wire coils may look like thirty cents and perform like thirty dollars, or it may look like a million dollars and perform like a plugged nickel.

Bad Screen Grid Tubes

BEFORE the development of the screen grid tube, it was uncommon for tube failure in the radio-frequency stages of a radio receiver to cause a noticeable falling off in tone quality from the loudspeaker. Weak tubes in this part of the circuit merely cut down signal strength.

In modern screen grid circuits, the tone quality also suffers, particularly when the weakened screen grid tube happens to be in the stage of radio-frequency amplification just preceding the detector. This tube gets such a powerful signal from the screen grid tubes in the preceding stages that it cannot, if partly exhausted, handle the load. As a result it does not pass to the detector the full radio-frequency wave and the tone becomes raspy and distorted. The obvious remedy is a new tube.

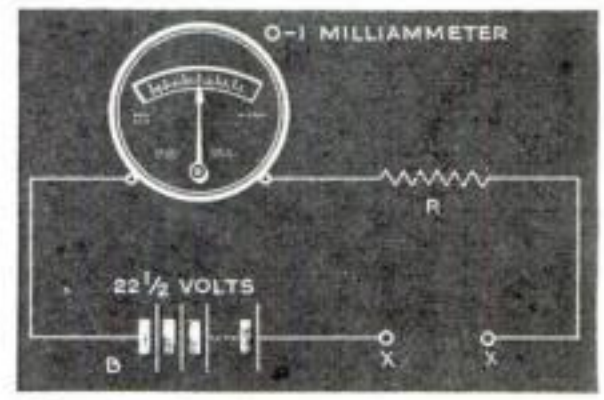


Diagram of milliammeter circuit in which it is possible to read resistance in ohms.

Space Winding

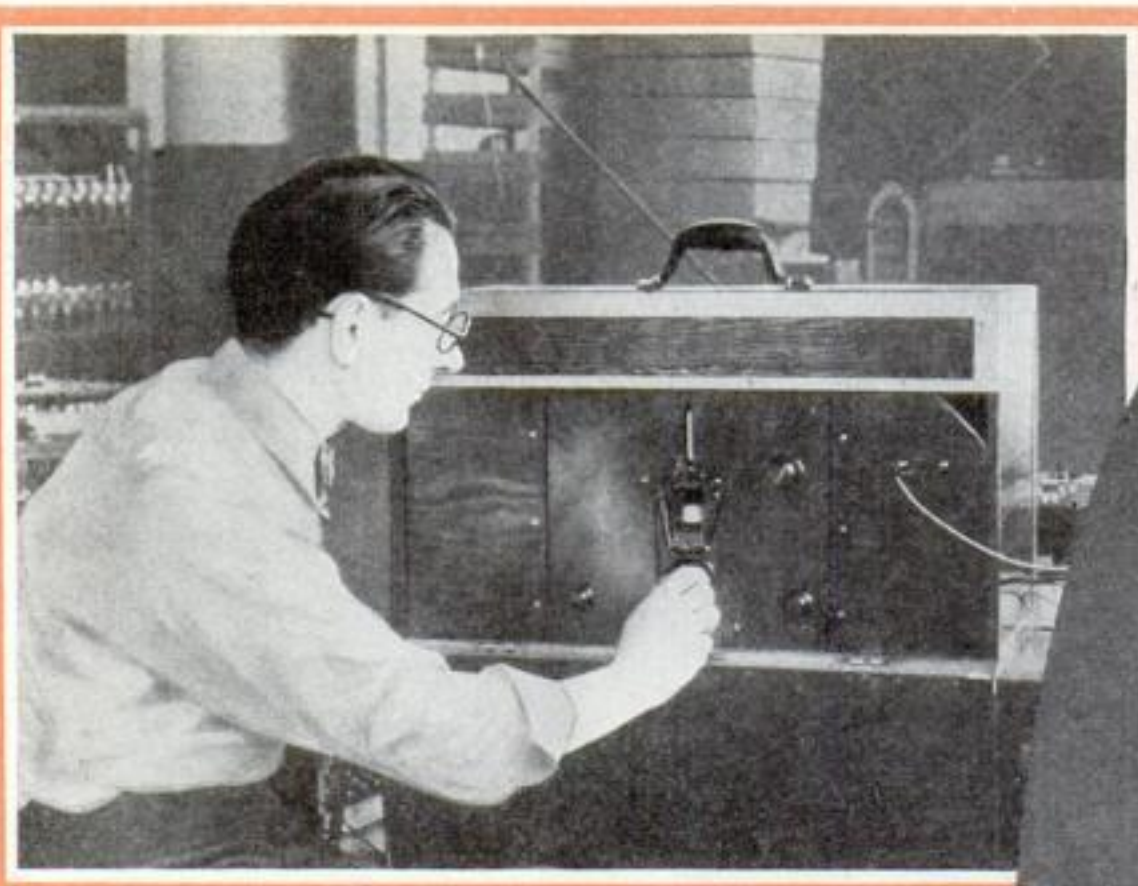
WHEN a radio tuning coil is wound so that there is a space between each turn and the next, the coil is known as space wound. This type of winding is often desirable in coils used for broadcast reception and is almost essential for short wave work except in the oscillator circuits of superheterodyne receivers where losses are relatively unimportant.

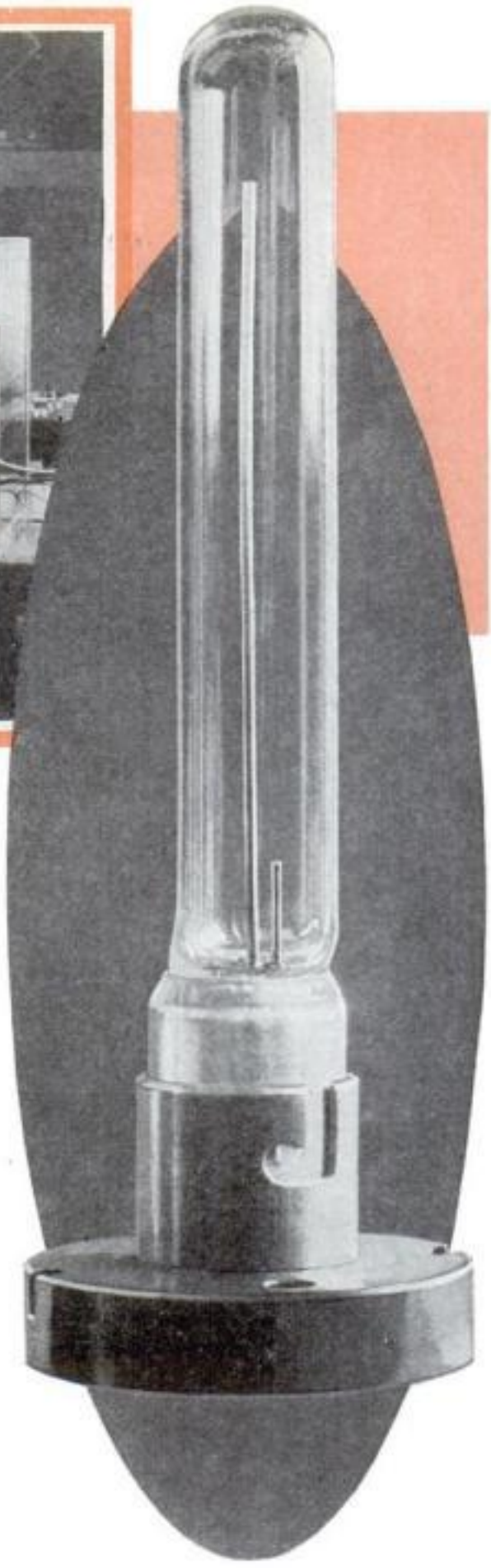
The reason why space winding is so necessary in short wave coils is because it reduces the electrical capacity.

This is especially desirable on the extremely short waves because the by-passing effect on these higher frequencies is much more marked than on waves in the broadcast band. Capacity is needed in the tuning circuit, of course, but it should be in the tuning condenser.

Beginners at short wave work wonder why such large wire is used to wind coils used to tune these waves. High frequency current has a tendency to travel on the surface of a conductor, and this effect is more pronounced as the frequency becomes higher. Large wire has more surface than small wire, offering less resistance to high frequency current.

With this new method of tuning, the eye, not the ear, guides you in getting the correct dial setting





NEON TUBE *glows as you* Tune *by Sight*

By ALFRED P. LANE

A WEIRD column of red light that flows up and down inside a thin glass tube like the red liquid in a thermometer is the latest thing in visual tuning for the modern radio receiver. Instead of jiggling the dial back and forth until the station seems loudest. the new tube makes it possible to tune a station with mathematical accuracy even though the loudspeaker be disconnected.

The pressing need for adequate visual tuning has been brought about by the universal adoption of automatic volume control. This method of regulating loudspeaker volume (P. S. M., July '30, p. 71) was used on only a few of the higher priced sets last year, and was considered an important improvement. Next season. however, automatic volume control will be part of the circuit of every receiver with only a few exceptions in the lower priced, midget class.

When you tune an ordinary receiver not fitted with automatic control of the volume, you first hear a station faintly as the dial is moved toward the proper setting. The signal grows louder and louder till it reaches a peak value and then, with further movement of the dial, it rapidly drops off. Obviously, it is easy to set the dial at the point where the signal is loudest and then turn the volume control knob till the volume suits you.

With automatic volume control, the sound effect you get as you turn the dial is entirely different. The station is heard faintly as you approach the proper setting, but after it increases in volume to the point for which the automatic control is adjusted, further movement of the dial makes no change in the volume. On powerful local stations the volume may remain uniform for several degrees on the dial.

The tone quality is correct only at one point, however, and with no change in volume to act as a guide in finding this true tone point, the set owner never knows whether his receiver is correctly tuned or not.

The amount of static noise coming from the loudspeaker is a partial indicator, as the automatic volume control decreases the sensitivity of the receiver right at the peak of the wave. Tuning for minimum static noise is, therefore, a rough way of setting an automatic volume control receiver on the peak of the incoming wave where the tone quality is as fine as possible.

In the past, various methods have been employed to simplify the tuning of automatic volume control receivers. Mechanical logging was one way. This arrangement mechanically flashed a light when the dial reached the point where the radio station was supposed to be in tune. Being mechanical, the apparatus worked by the rotation of the dial and had no actual connection with the receiving circuit.

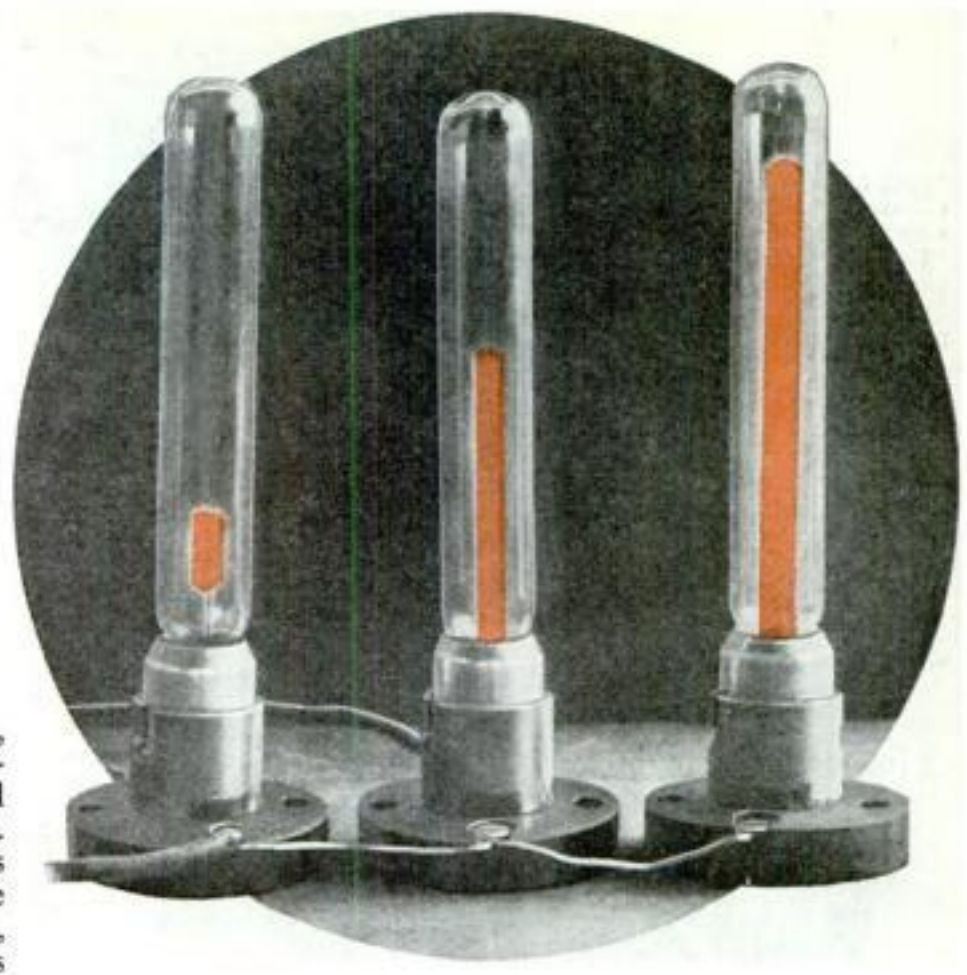
Another method, employed on some high priced receivers, was the use of a meter mounted on the front of the receiver and connected into the plate circuits of the radio-frequency amplifier tubes. By watching the gyrations of the needle it was possible to tune a set accurately to the peak of the wave. To be of any use, meters for this service have to be carefully made and they are expensive, adding to the selling price of the receiver. Aside from that, the reading of a meter is difficult for most radio fans.

Top, tuning a radio set by sight. Above, new tube in which red light guides the dial.

The new tubular glow indicator is a specialized development of the neon tube, the brilliant red glow of which is now so familiar in advertising signs. The glass portion is long and slender. There are two electrodes; one is a short piece of wire that extends up from the base about a half inch, and the other is a straight piece of wire that reaches nearly to the top of the tube.

It is connected into the plate circuits of the radio-frequency amplifier tubes in

This Article Describes New Marvel in Radio That Makes It Possible to Find Peak of Volume from a Station With Loudspeaker Disconnected



Of the three tubes shown here, the one at left is warmed up and ready for use. Next, the red glow rises as station is approached and last glow nears top of tube at tuning peak.

The meter on this set is another method of visual tuning, but meters are hard to read.

an arrangement technically different from that used for the meter indicator already mentioned. It cannot be substituted for a meter in a set already in use. It is mounted behind a narrow slot in the front panel of the cabinet.

When you first turn on a set fitted with one of these tubes, the entire slot appears to be filled with bright red light. Then, as the tubes warm up and are ready for action, the red glow falls nearly to the bottom of the slot, assuming, of course, that the receiver happens not to be tuned into a station that is broadcasting at that particular moment.

After this happens, turning the dial will cause the red glow to rise in the slot each time the tuning passes through the wave of any station received with sufficient strength to be heard on the loudspeaker. To tune in any station it is only necessary to adjust the dial so that the glow rises to the highest point.

The sounds coming from the loudspeaker, whether broadcasting or static, have nothing whatever to do with the tuning function when one of these thermometer-like tubes is used. This allows switching off the speaker while tuning, eliminating the raucous grunts and squawks usually heard as the wave of each station is passed.

This new form of visual tuning probably will prove of great advantage to radio fans who are enthusiastic about bringing in distant stations, for every distant station that comes in with strength sufficient to be worth listening to on the loudspeaker will cause at least a slight upflow of the red glow. Users of receivers fitted with the new tube should, therefore, be able to locate and accurately tune distant stations with the loudspeaker turned off—a boon to the neighbors when you stay up to go after some of the far-away places late at night!

Sounds Reveal Flaws in Condenser Paper

QUEER noises from radio headphones now give the facts about the quality of the paper used as insulation in many types of radio condensers.

Condenser paper is made extremely thin so that the bulk of the condenser may be kept within reasonable limits. Thick paper would reduce the capacity effect of the metallic sheets between which it is placed.

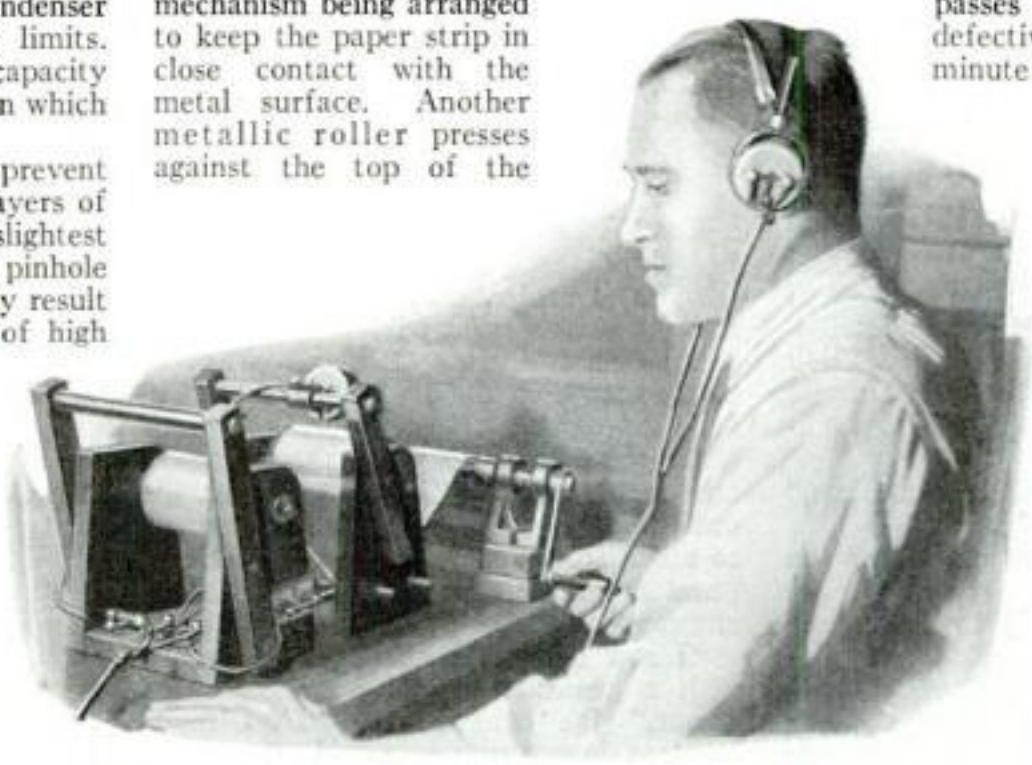
This thin paper must, however, prevent the flow of current between the layers of tin foil or aluminum foil. The slightest trace of metallic grit, or even a pinhole of the tiniest size, would eventually result in a breakdown under the strain of high voltages.

Furthermore, a peculiarity of condenser paper is that defects are not always revealed by high voltage tests of the complete unit. A condenser might pass such tests with a perfect rating, only to break down a day, a week, or a month later and ruin the operation of the set in which it is fitted.

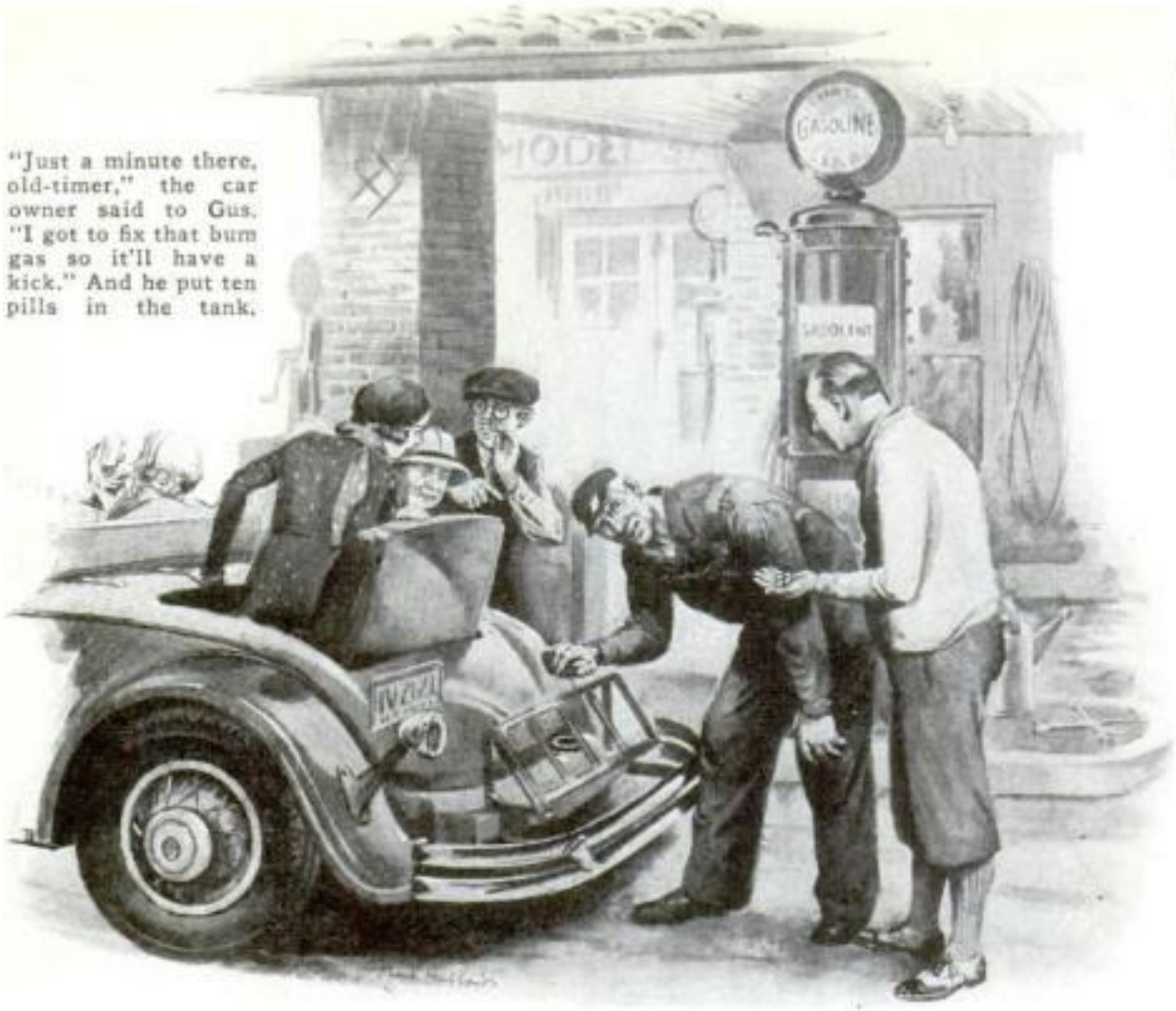
Inspection by eyesight alone is not sufficient, because the paper may contain metallic particles so fine as to be virtually invisible to the naked eye.

In the novel testing machine shown, a strip of the paper is slowly rolled over a metal drum, the feed mechanism being arranged to keep the paper strip in close contact with the metal surface. Another metallic roller presses against the top of the paper, thus squeezing it between the two metallic surfaces.

Connections are made so that an electrical voltage is applied between the upper and lower rollers. As the paper passes between the rollers, a defective spot is indicated by a minute amount of current flowing through the metallic particle or by a slight change in capacity effect in the case of pinholes. An audio amplifier is attached in such a way that these slight variations are greatly magnified and then fed into the headphones. As the tester turns the crank, pulling the paper through the rollers, silence in the phones indicates perfect paper. Any kind of scratching, clicking, or hissing noise audible in the earphones indicates a defect in the paper at the point where it is passing between the rollers.



As flaw in paper passes between rollers, sound is heard in headphones.



"Just a minute there, old-timer," the car owner said to Gus. "I got to fix that bum gas so it'll have a kick." And he put ten pills in the tank.

PILLS *Won't Give Your Gas* More Power

By MARTIN BUNN

"GIMME ten gallons of plain gas!" the owner of a smart roadster called out as he pulled up in front of the Model Garage.

Gus Wilson, half owner of the garage and mechanical mainstay of the establishment, unlimbered the hose and turned the crank for the required ten gallons.

As he was about to replace the cap on the tank, the owner pushed him aside. "Just a minute, there, old-timer," he commanded. "I've got to fix that bum gas so it'll have a real kick to it."

He fished a bottle out of the car's door pocket and counted out ten small pills which he dropped into the gasoline tank.

"There," he said, replacing the cork. "This dope makes cheap gas work better than the high-priced stuff you sell out of the other pump."

"Smart lad that, eh, Gus?" Joe Clark grinned to his partner after the customer had gone. "What are those pills he put in the tank?"

"Oh, they're probably harmless," returned Gus noncommittally.

"But he said they made the motor run better," Joe persisted.

"A sap like that's likely to say almost anything," Gus growled.

"That stuff he put in his tank is only one of about a hundred different dopes for gasoline. And not one of 'em adds one fly-power to an auto engine."

"But how about that doped gasoline we sell from the high-priced pump?" Joe asked.

"That's a different matter," Gus replied. "That gas is doped with tetra-ethyl lead, which you can't buy separately. Leaded gas is all right. It increases the power by stopping the knocking, but those pills, powders, and such don't do anything."

"Why didn't you tell that bird his pills were no good?" Joe asked.

GUS smiled. "Why should I? In the first place he didn't ask me. In the second place he probably gets a lot of fun out of thinking how smart he is. Besides, the directions with most of those dopes tell you to cut down the gas at the carburetor, which is good advice. Any driver that wants economy usually can get it by cutting down on the gas. The motor will start harder and take longer to warm up and maybe not have quite as much power on the hills or on the getaway, but the owner will save money and he won't have so much trouble with carbon. Most carburetors are set for too rich a mixture anyway."

"I saw one of those dopes advertised with a guarantee of fifty percent more power," Joe commented. "How much increase do you suppose you'd actually get with that stuff?"

"If you want to read fairy stories, go down to the library!" Gus exclaimed. "Those pills would give you just exactly no increase in power and you'll find that the U. S. Bureau of Standards, after testing dozens of 'em, says the same thing.

"Just suppose," he went on, "you really could drop a few pills in the gas tank and increase the power of the motor fifty percent. What would happen? If you opened the throttle wide, you'd rip the rear end to pieces or maybe smash the crankshaft.

"SPEAKING of what happens when you boost the power with dope," Gus added with a reminiscent smile. "Years ago there was a bird—I'm not mentioning any names, because he's a prominent aviator now—who figured out a way to dope the gasoline he put in the tank of his motorcycle. He entered an economy contest and actually covered about two hundred miles with just one gallon of his concoction. Of course he won the event.

"Later on he entered a couple of hill-climbing contests and then the fun started. In a tryout he flew up the hill like a shot out of a gun, but when he started up for the real test, one of the cylinder heads blew off and he almost passed on to the happy hunting grounds."

"What on earth did he use?" Joe exclaimed. "I thought you said there wasn't any kind of a dope that would do that."

"There isn't," Gus explained. "No one would dare sell such a dangerous explosive for auto use. He dissolved picric acid—they use it in making explosives and it's about as safe to experiment with as dynamite—in ether, and dumped the solution into his gasoline. Besides being dangerous, the stuff is so corrosive it chews the stuffings out of the motor."

"But those gasoline dopes are supposed to remove carbon," said Joe. "Is that bunk, too?"

"Anybody who knows what the carbon deposit in a cylinder really is, knows there isn't any chemical that would actually dissolve the carbon itself, and the gummy, tarlike, broken-down oil that holds it stuck to the cylinder head and piston can be dissolved only by a powerful solvent.

"As a matter of fact," Gus went on, "a long hard run in hot weather with the carburetor set for a real thin mixture will burn away a lot of the carbon deposit in any modern motor. That's how some gasoline dopes got their reputation for removing carbon. A thin mixture and a hard run did it and the pills got the credit.

"It all boils down to just this, Joe," Gus concluded, "the power you get out of gasoline comes from the heat that develops when the hydrogen and carbon of the gas burns in the oxygen of the air that goes in through the carburetor. Putting pills in the gas tank isn't going to increase the oxygen in the air going through the carburetor and it isn't going to increase the amount of hydrogen or carbon in the gasoline—gasoline is all carbon and hydrogen anyhow."

"But aren't some of the dopes good as antiknocks?" Joe asked.

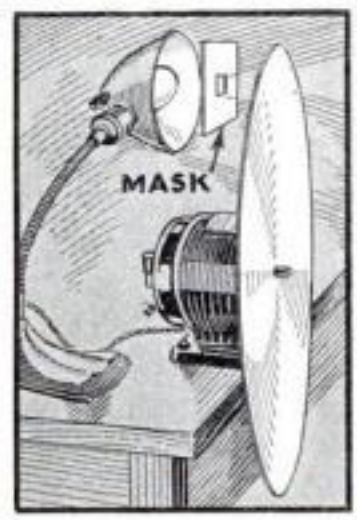
"Not one is nearly as good as tetra-ethyl lead," replied Gus. "Gasoline dopes sell to the suckers, the fellows who buy phoney stock and fake medicines—the fellows who would rather believe a lie than go to the trouble of finding out the truth!"

An Easy Way to Make an Accurate *Scanning Disk*

. . . THE HEART OF YOUR TELEVISION RECEIVER

By George H. Waltz, Jr.

IN THIS article, George Waltz, who has already told you about his visit to a television studio and his shopping tour for television parts, takes you into his home workshop and tells you just how he went about making the scanning disk for his "vision" receiver. Even if you are not building a television set, you can keep abreast of the latest developments by following along as he proceeds.



Don, my neighbor, showed me how it was possible to test the accuracy of a scanning disk by using a drop light and a mask of tissue paper.

• • •

"WHAT'VE you been doing—buying out the five-and-ten?" my neighbor Don Marshall called out as I staggered up the front steps with the load of television parts I had bought on the shopping tour I described last month.

I dumped the bundles on the top step and fished for my door key. "All this, let me tell you, is a television receiver—or at least it will be when I put the parts together. See what you got me into when you handed me that invitation to station W2XCR!"

My neighbor grinned. "How much did all that set you back?" he chuckled as he helped me carry the stuff down to the cellar where I have my workshop.

"Oh, about fifty dollars—more or less," I told him. "I guess I'll tackle the scanning disk first; that's going to be the hardest job." I carefully unwrapped the 12-in. blank disk and laid it down on one end of my workbench. Then I hunted up some large sheets of drawing paper that would be just the thing for the layout.

"Let's see," I said, half to myself, "since I'm going to follow the standard sixty-line scanning arrangement, I'll have to have sixty holes arranged evenly along a spiral. The spiral must have a pitch equal to the height of the image I plan to receive. Now, there are three hundred and sixty degrees in a circle and since there are to be sixty holes, they will have to be spaced six degrees apart. Is that right?"

"Seems O. K.," replied Don, who is a radio expert and television experimenter.

First, I set my large compass and drew an 11-in. circle, figuring that this size would give me the extremity of my spiral, making it less than the full 12-in. diameter of the disk. Then I stepped the circle off into 60 parts with my dividers and drew in the radial lines to the center.

"Don't forget that only one hole must pass in front of the plate of your neon tube at one time," Don cautioned as he looked over my shoulder. "In other words, the width of the image you can receive is equal to the distance between two radial lines where they intersect the circle."

"But that will give me an image only about one half inch square, and I want one at least one and one half inches square. That's why I bought a neon tube with a one-and-one-half-inch plate. Don't tell me I've made a mistake already!"

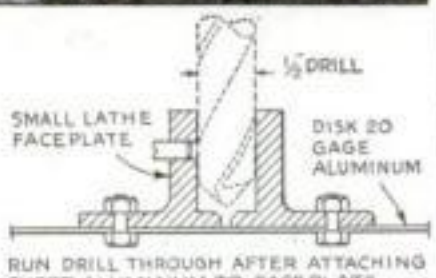
"Well, you see," said Don, "you forgot when you bought that twelve-inch disk that only one hole should be in front of the neon plate at any one time. In order to take full advantage of that one-and-one-half-inch plate, you'll have to have a larger disk. Of course, you can use that small disk with the one-and-one-half-inch neon tube, but you can get only a small image."

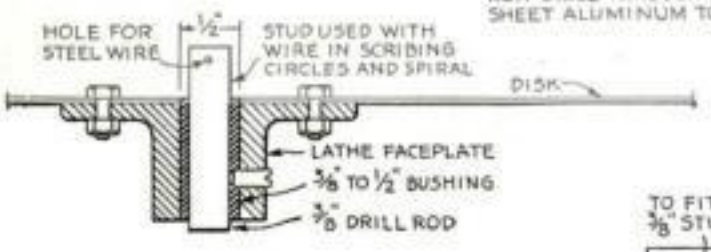
"How can I tell how large the disk has to be?" I asked.

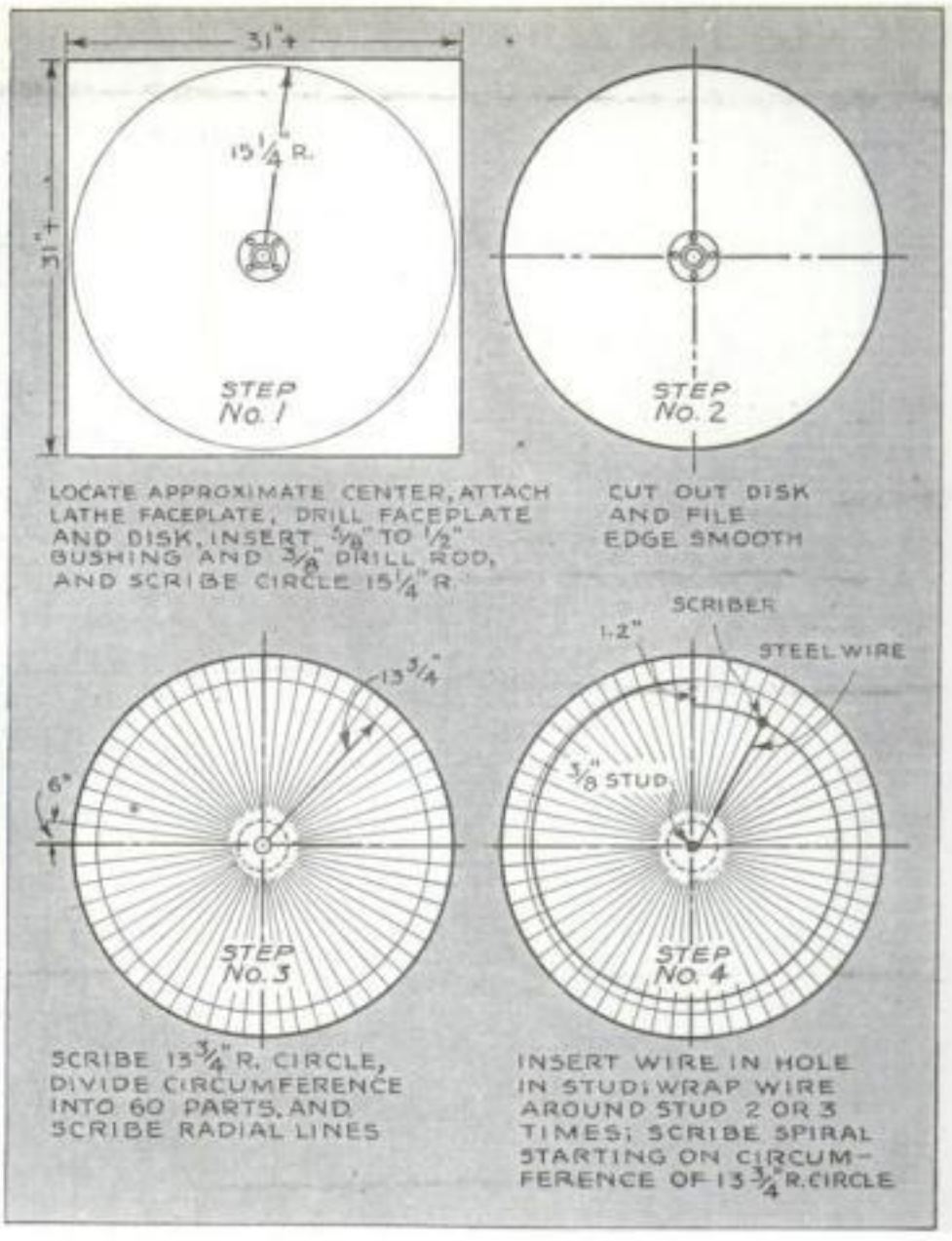
"Just continue those radial lines you have drawn until the distance between two lines approximates one and one half inches. Don't forget that in sixty-line scanning, the height of the image is to the width as sixty is to seventy-two."

I drew the lines and after juggling a few figures in a 60 to 72 ratio, I found that in order to keep within the boundaries of the neon plate the height would be 1.2 in., the width 1.44 in., and the

Above: Scribing the spiral by wrapping the wire around a ⅜-in. stud. *At right:* A ½-in. lathe faceplate, drilled through, is used as a hub for the disk. *Below:* A ⅜ to ½ in. bushing is inserted in the faceplate to take the ⅜-in. stud.







The four fundamental steps in the laying out and drilling of an accurate scanning disk. The ⅜-in. stud is used in scribing the circle and spiral.

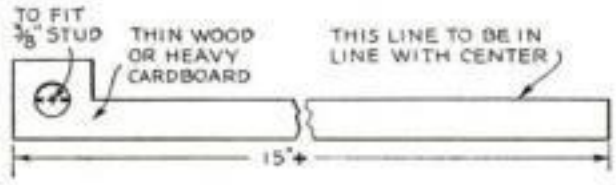
radius of the extreme circle would be 13¾ in. Also, I figured that since 1.2 divided by 60 gave me .02 in. for the diameter of the holes, I would have to use a No. 76 drill.

"That's what comes of buying a lot of stuff without making sure first just what you need," I grumbled as I checked my figures. "Why the dickens didn't you tell me I was wrong when you saw that I had a one-and-one-half-inch neon tube and only a twelve-inch disk. Figuring this way, I'll need a disk at least thirty-one inches in diameter. Where can I get one that large?"

"YOU can make one, can't you?" Don said. "Go down to one of the large hardware stores and buy a piece of sheet aluminum the right size, and cut out the disk. Of course, you can buy a large disk all cut if you want to, but it will cost you more."

Next day I purchased two big squares of sheet aluminum, 20 gage. I bought two pieces because after looking at the small hairlike drills I'd have to use, I wasn't any too sure that I could make a good job of it at the first attempt.

Several nights later I was again in my shop preparing to lay out the spiral and drill the holes. Using the 13¾-in. radius I had obtained by my calculations a few nights before, I drew in the extreme circle on a large sheet of drawing paper and proceeded carefully to step off the 60 equal parts around the circumference. After drawing the radial lines and the



How the straightedge used in scribing the radial lines is cut from wood or cardboard.

spiral having a pitch of 1.2 in., I located the 60 holes. Before going further I scribed a 30½-in. diameter circle for the disk, mounted the square of aluminum on a wood turning lathe faceplate as shown in one of the sketches, and then cut the disk to the circle.

Next, I placed the paper layout over the disk and with a sharp prickpunch located the centers for the holes on the metal. With my flexible shaft drill and some of the fine No. 76 drills I proceeded to drill the holes. I broke five drills before I finished—those tiny drills are such pesky things to work with!

As I lifted my drill from the last hole, I heard footsteps on the basement stairs and I guessed that the light from my cellar window had told Don I was at work.

"Well, Don," I said, holding up the shiny disk, "here she is, all finished!"

"How does it work?" he asked.

"What do you mean, how does it work? Of course it'll work all right, but I'll have to wait until I finish the whole receiver before I can try it out."

"No you won't," Don interrupted. "We can test that disk right now if you want to." As he said this he walked over to the motor, which I had hooked up earlier in the evening, placed the disk on the shaft, and tightened the set screw in the lathe faceplate I was using as a hub.

"Now," he continued, "all we have to do is place a strong light behind that disk with a piece of tissue paper over it framed to the size of the image, and then go around in front and see how it looks."

Working together, we fixed up a drop-light and tissue paper and turned the switch that started the motor. As the large disk gained speed, a small rectangle of light became visible. I was disgusted to find, however, that the illumination was not uniform. The light was streaked with irregular bright and dark bands. Before I could speak, Don said, "Not so hot! Those funny looking bands come from not having the holes accurately located and drilled. Half the fight in making one of these disks is to get the spacing of the holes uniform and arranged on an accurately drawn spiral. The bright streaks are formed by the holes' covering overlapping portions of the ground glass. I'm afraid you won't be able to use that disk in your receiver."

"It's beyond me," I said, keenly disappointed. "Just how would you go about drilling it? I laid the spiral out accurately on a sheet of paper and located the holes carefully. I don't know of any better method than that."

"You made your mistake by laying the holes out on the paper. Why didn't you do all your work right on the metal in the first place?"

"IT'S lucky that I had a hunch I might make a false start and bought two sheets of the aluminum. If you have the time, Don, I wish you'd stay and help me get started right."

Don acquiesced with a nod. "First,"

he said, "we'll locate the approximate center of this square of aluminum by drawing the two diagonals. Then we'll mount the lathe faceplate right over the center. The most important thing in making a television disk," he continued, "is to get the spiral accurate. That's the heart of the whole job. The best way I know of to do that, short of making a complicated special fixture, is to fit a stud having a circumference equal to the pitch of the spiral you desire into the center of the disk. Then, by winding a wire around the stud for one revolution and holding a sharp scriber in a loop at the other end, it is a simple matter to obtain a good spiral. You see, as the wire winds around the stud, it shortens the radius and pulls the scriber in towards the center. One complete revolution will give you the spiral you need. Now let's see—in your case the pitch of the spiral is one and two-tenths inches." He picked up a pencil and began figuring. "From the formula for the circumference of a circle, that will mean that you will need a three-eighths-inch diameter stud. A piece of drill rod will serve very nicely."

"But, Don," I interrupted, "I haven't any steel wire around here."

"YOU play the mandolin, don't you? We can use the metal E string from that. It will be strong and not large enough to introduce any appreciable error. It has a loop on one end, too, that will be just the thing for the scriber point. Another thing," Don continued, "we have a one-half-inch hole in that faceplate, so we'll have to bush it to take the three-eighths-inch stud."

Don slipped the 3/8 to 1/2 in. bushing into place and then inserted the 3/8-in. stud. "Now," he said, as he straightened the E string I had taken from my mandolin, "we are ready to go ahead. First we'll use it to scribe in a fifteen-and-one-quarter-inch radius circle for the outside of the disk."

It didn't take long to scribe in the circle, and when I finished Don picked up the tin shears and cut away the excess metal. After the cutting had been done, he mounted the disk on the motor and trimmed it smooth with a file held against the edge as the disk revolved.

"The next thing to do," Don said, "is to scribe in the thirteen-and-three-quarter-inch extreme circle, divide it into sixty parts, and scribe in the radial lines."

"How can we draw in the radial lines," I asked, "when we have lost our center on the disk and now have a stud in its place?"

Don started making a sketch on a scrap of paper. "While I'm scribing in this circle, you cut out a piece of plywood to the shape I'm sketching. [Center of page 72.] The hole should fit over the stud, and the upper edge should be in line with the center of the hole. You see, we can slip that over the stud and use the upper edge as a straightedge."

When the radial lines were drawn, Don scribed in the spiral, using the steel wire in the method he had described. "The important thing in this operation," he said as he adjusted the length of the wire so that the scriber rested on the intersection of the extreme circle and one of the radial lines before he started to scribe the spiral, "is to be sure that you keep the wire taut. The wire, as it wraps around the stud, will give an accurate spiral automatically."

Working with a magnifying glass, I carefully located the center of each hole with a punch and then, with my flexible shaft, I proceeded to drill the 60 small holes. This time I broke only three drills.

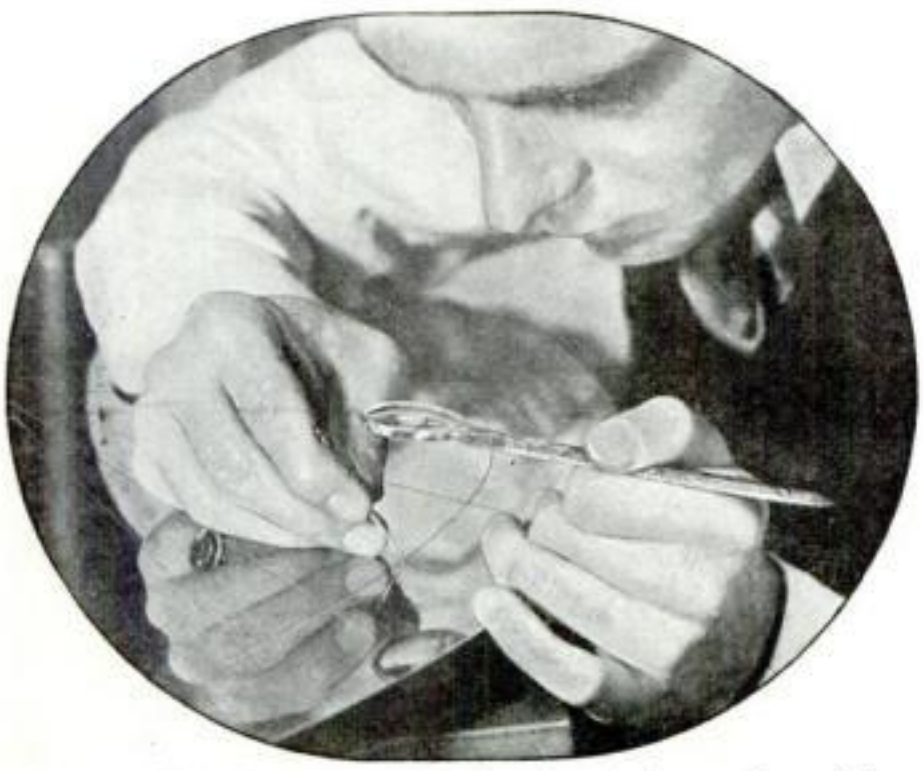
After all the holes had been drilled, we mounted the disk on the motor shaft and rigged up the light to test the accuracy of the holes. "I think," Don said after the disk had reached its full speed, "that while that light coming through is even enough for a television image, we will get better illumination if we run a No. 73 drill through the holes to enlarge them slightly, and countersink each with the point of a larger drill. You see," he explained, "the light is uniform enough, but it is not very brilliant. That's caused by the fact that the portion of the image covered by one hole just butts up against the portion covered by the preceding one. The larger holes will give you a trifle more overlap and consequently better illumination."

"Well then," I said, "I guess that finishes up the scanning disk. The next on the schedule is the short wave receiver and amplifier, isn't it, Don?"

"That's right, and when you build the set don't forget that you have to get an extra loud signal on the speaker if you expect a decent image on the disk. Let me know when you get started."

"I'll let you know," I said as Don climbed the basement stairs. "I'll need your help with that too."

In drilling the scanning disk, hairlike No. 76 drills were used. Care was taken to keep the drill vertical.



A magnifying glass was used in locating the intersections of the radial lines and the spiral. Accuracy at this point is important.

George Waltz is now at work building the short wave receiver and amplifier for his television receiver, and next month he will tell you just what luck he had. Meanwhile, if you have any questions to ask about television, address the Technical Editor, POPULAR SCIENCE MONTHLY, *and inclose a self-addressed, stamped envelope for reply. Be sure to state your questions clearly.*

TRASH HEAP PROVIDES PARTS FOR MODELS

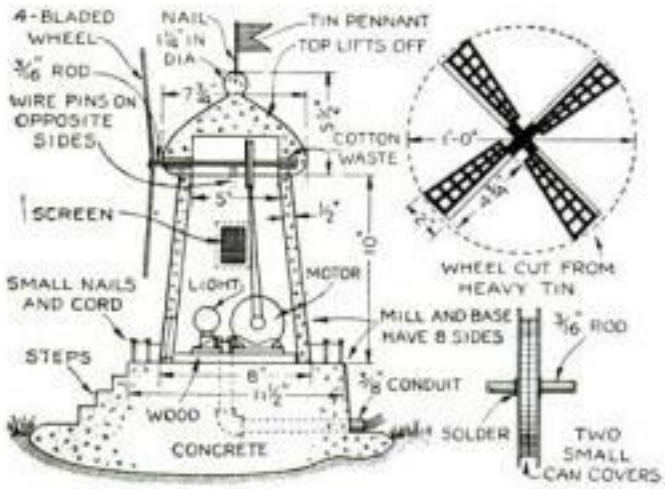
MANY parts of my ship and airplane models were retrieved from the trash heap. It is truly said that the junkman is the ship modeler's best friend. A finished appearance can be given the cabin windows of a galleon or similar ship model by gluing a strip of mesh from an old fly-swatter behind them and painting the wire and the edge of the window openings gold or any desired color. Shoe eyelets, obtained at a shoe repair shop, make inexpensive deadeyes for small, simplified models. It is necessary, however, to borrow or buy the special tool required for pressing the parts together. Pinch them almost closed, with just enough space between the edges to allow the cord to go around. Eyelets also can be used for blocks, and they make neat portholes if glued into tight-fitting holes drilled in the hull.

The fuselage for certain types of scale model airplanes can be turned in a lathe. For planes such as the Lockheed Vega and the Vought Corsair, the fuselage can be turned from nose to tail; then the body is planed to make it oval in cross section. A fuselage like that of the Travel Air "mystery" plane can be turned from nose to rear of cockpit, and the remainder finished by whittling it to shape in the usual way.—W. E. TROUP.

TINY MODEL WINDMILL DECORATES GARDEN

A TOY electric motor instead of the wind turns the vanes of this illuminated garden mill, which is 8 in. wide at the bottom and 15½ in. high. The walls are of ½ in. thick concrete made over an eight-sided wooden form, on which thin blocks of wood had been fastened to indicate where the door and window openings were to come. The mortar, consisting of one part cement to three parts of sand, was laid on with a trowel. When half the thickness had been applied, small pieces of screen were laid in to represent the window sash; then the rest of the wall thickness was built up.

The top was made removable. Besides being surmounted by a pennant, it contains holes in which the wheel shaft runs, lubricated by oiled cotton waste. A pulley consisting of two small tin can covers is soldered to the shaft. Below, mounted on a wooden base, is a small motor. The belt is a rubber band, which stretches enough to allow the parts to be assembled without difficulty. Note that the shaft pulley is mounted slightly ahead of the motor; the slight backward pull thus keeps the wheel shaft properly seated at all times. The



wheel was cut as shown from a 12 in. diameter disk of rather heavy sheet metal, and painted.

To receive the mill, a concrete foundation block was prepared, with conduit cast into it as shown. Miniature steps lead down from this base on one side, and there is a handrail around it made by setting threepenny nails 5 in. apart and wrapping cord around them. A miniature light socket was fastened to the wooden base and wires run from this and the motor through a conduit to a 6-volt storage battery in the house. The mill could be operated just as well by current from a doorbell or toy transformer.—DALE R. VAN HORN.

STAINED and discolored developing trays can be cleaned by immersing them in old acid hypo solution. The trays should soak for twenty-four hours.

SPRING HOLDER KEEPS WORK GLOVES HANDY

MUCH more convenient than a nail or hook for holding one's work gloves is a spring clothespin. To mount it, the clothespin is taken apart and a ⅛-in. hole bored through one of the jaws so that it can be fastened to the wall with a screw. Then the clip is reassembled by slipping the jaw back under the spring. This holder opens readily at a finger's touch to receive the gloves, and releases them at either a quick jerk or a steady pull. If placed near the coal-bin light switch, the clothespin is a more potent reminder to replace the gloves than a nail or hook would be.—ELTON STERRETT.

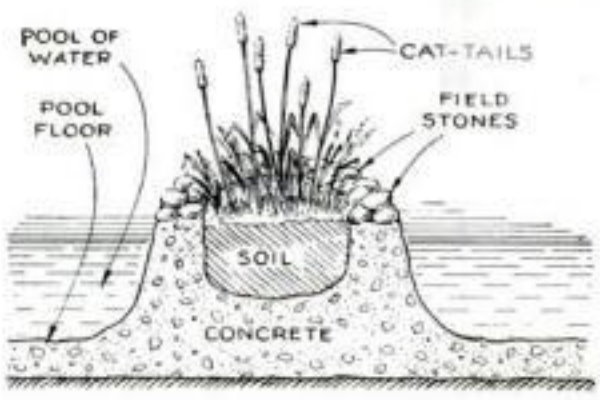
A VERY satisfactory silver plate can be obtained on copper without electricity by the following method: Clean the pieces of copper to be plated by immersing them in ordinary commercial nitric acid—a few seconds should be sufficient in most cases. When thoroughly clean, suspend the copper articles in a tray containing an old acid hypo fixing solution that has been used in fixing a quantity of film or prints. This old hypo contains a certain amount of silver which it has collected from the fixed prints, and it is this silver which becomes deposited on the metal. The thickness of the plate depends upon the time the articles are left in the solution. When thoroughly dry, the pieces may be buffed.—D. H.

METAL BAND PROTECTS BIRDS IN TREES

WITH its close-set, bristling points, the metal band illustrated forms an impassable barrier against cats and other animals that might attempt to climb the tree to kill birds and rob and destroy their nests. The band is made from a piece of galvanized iron 5 in. wide and as long as the circumference of the tree trunk. A line is drawn 1 in. from one edge to mark where the flange is to be bent up for attaching the band to the tree; then a series of cuts are made from the other edge to the line, and triangular-shaped pieces are clipped off the ends of each tab to form 1½ in. long points, which are bent outward as shown.—DUKE D'AMBRA.

GARDEN POOL HAS CONCRETE ISLAND

AN ARTIFICIAL garden pool, even of small size, can be made more realistic and attractive if it contains a real island decorated with appropriate plantings. To form the island, rocks can be piled up one layer on top the other in the usual way, but a far better plan is to build a cone of concrete, cap the edges with irregularly shaped field stones, and then fill the interior with rich earth to receive the plants. A few bent pieces of scrap iron or even old woven wire will make a good



form upon which to plaster the concrete mortar for the cone. No other forms are needed. The top of the island is brought up about 6 in. above the water level. The island shown in the photograph above is planted attractively with cat-tails. The plants get plenty of water by seepage through the concrete, and in the case of the pool illustrated, which is used by children for bathing, water is often splashed on them. The attractiveness of the island will depend on the choice of plantings and stones used.—JACK ROOD.

Joint Cutting *on a* Power Saw

W. Clyde Lammey *shows how easy it is for the home craftsman to rival the work of skilled cabinetmakers*

Fig. 1. Cutting a tenon with a dado. The ripping fence is used as a stop. *At right:* Fig. 2. The first step in cutting a miter lock joint.

FOR years the home craftsman has been obliged to design his shop projects within the limitations of hand tool methods. He has had to keep in mind the difficulties and inaccuracies of handwork. But all this is changed now that small, reasonably priced power tools have come into general use, and he is able to duplicate every essential operation found in the best cabinetmaking.

After all, good cabinetmaking is mainly sound, accurate joinery. With nothing more than a small power saw, the amateur can make a large variety of difficult joints, some of them virtually impossible by hand methods.

The four corner joints shown at *A-D*, Fig. 9, are typical. The first is a simple rabbeted corner joint and needs no explanation. The tongued rabbet *B*, which is an elaboration of the first, is much stronger. The first member is laid flat on the table, guided by the miter gage, and the cuts are made in the position shown with the single outside cutter of the dado head.

On 13/16-in. stock the groove and rabbet which take the projections of the finished second member are run to a depth of 9/16 in. The table is then raised so that the cutter runs to a depth of 3/8 in., and the projection between the groove and rabbet is trimmed off. The groove and rabbet should be run twice the thickness of the cutter, or ¼ in. in width. This leaves a center projection 5/16 by 3/16 in. in size.

Raise the table so that the cutter will run 3/16 in. in depth and set the rip fence to measure 19/32 in. from the side of the cutter opposite the fence. Set the second member on end, run the first cut for the groove, then turn it about and run the second. There will be a thin strip of waste at the center which may be trimmed out by sliding over the cutter a third time. If care has been taken in the setting and the measurements, the joint will be a tight fit.

The third joint *C*, Fig. 9, is generally known as the miter lock joint—one of the strongest corner joints. The first and second operations on the first member of this joint are shown in Figs. 2 and 3. On 13/16-in. stock the first miter cut is run at an angle of 45° and to a depth of 7/16 in., measuring parallel with the cut. This must be done in one operation on all pieces to be joined in order to keep the same setting on the table.

Next, the table is brought back to the level position, set for a depth cut of 7/16 in., and the waste under the miter cut is removed; the angle and vertical cuts meeting at a point. This removes 5/16 in. of the end. Measure ½ in. from the vertical cut and strike a line across the face and both edges of the stock. Set the dado to cut ¼ by ¼ in., hold the stock against the miter gage, and run the groove with the edge exactly to the line. This groove takes the tongue of the second member, as will be seen in the drawing (Fig. 9).

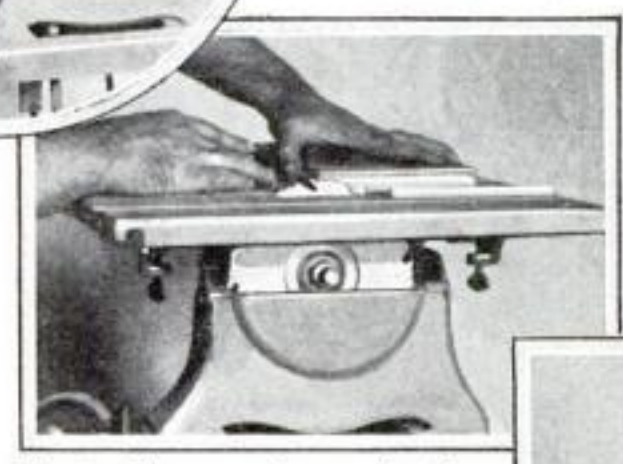


Fig. 3. The second operation in the cutting of a miter lock joint.

The second member is held vertically against the ripping fence, which is set at 5/16 in., measuring from the side of the fence to the adjacent side of the dado. The dado is set to cut a groove 13/16 in. in depth and ¼ in. in width. The side of the work on which the miter is cut is held against the fence. The tongue is then cut to ¼ in. length.

The fourth joint *D*, Fig. 9, is a similar type of corner joint except that the tongue and groove are omitted and in their place a ¼-in. dowel is used. Otherwise the cuts are the same on 13/16-in. stock. It is very important to remember when making any of these joints, which require several operations, that each separate operation must be done on all pieces to be joined before the setting is changed. Only in this way can an accurate fit be assured.

At *E-H*, Fig. 9, are shown four common types of joinery, difficult and tedious with hand tools but easily made in a fraction of the time on a small power saw. The first is the housed mortise and tenon, a joint that must be carefully and accurately made if it is to be strong. The tenon always should be cut by using the miter gage and ripping fence in conjunction.

A common mistake in cutting tenons on the saw table is to use only the miter gage, trusting to the line to determine the accuracy of the shoulders, one with the other. The way to cut a tenon accurately is to set the dado for the depth and assuming, for example, that the tenon is to be ½ in. in length, use the two outside cutters of the dado head, which will cut ¼ in. wide when placed on the arbor. The ripping fence is then brought up and set to measure ½ in. from the side of the fence to the opposite side of the cutters. The fence acts as an accurate stop, while the miter gage guides the work (see Fig. 1). When the grooves have been run, the waste between the groove and the end is easily trimmed away with the cutters.

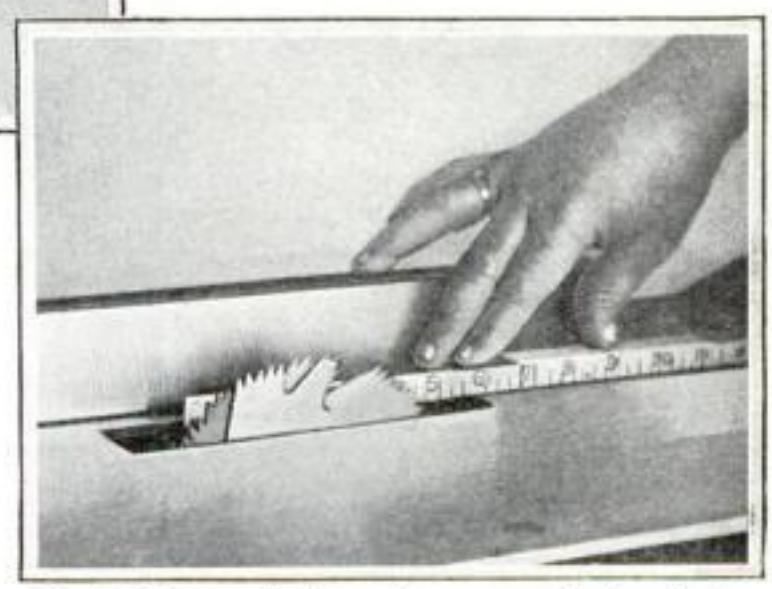


Fig. 4. How a scale is used to measure the length of cut prior to cutting a mortise with the dado saw head.

Though some hand chiseling must be done when making a mortise on the dado head, the machine insures all the mechanical accuracy necessary for a snug fit of the joint. First lay a rule along the head as in Fig. 4 and raise it until the distance between the teeth above the table equals the required length of the mortise. Then clamp a stop to the ripping fence, the distance from the edge of the stop to the back edge of the dado equalling the dis-

tance the end of the mortise is to be below the end of the work.

Set the ripping fence to bring the mortise at the center of the work, and hold the piece above the head and so as to bear against the ripping fence with the end resting against the stop as in Fig. 5. Then press it slowly down over the rotating cutters until it is level with the table. Lift it off the cutters by bearing down on the end that overhangs the table. Be very careful not to twist the work and bind the head while the cut is being made. Chisel the mortise square and to the required depth.

The making of the mortise and tenon joints in the corner housing *F*, Fig. 9, is similar. The mortises are cut to the same depth and the tenons are mitered at the ends and meet at the bottom of the mortises.

Panel framing is much used in the construction of small paneled doors. Though the type of joinery varies, that shown at *G*, Fig. 9, is practical and results in a very strong and rigid piece of work. When joining 13/16-in. stock, the groove in the stile is run to a depth of ½ in. and a width of ¼ in. The rail is then tenoned ½ by ¼ in. and a ¼ by ¼ in. groove is run, centered on one edge. When the frame is glued up, the panel fits in the grooves as illustrated.

The keyed or tongued miter *H* is cut in the same way as an ordinary miter, and the mitered ends are then kerfed with the saw to a depth of very slightly more than ⅜ in. in each. The key is ripped from 13/16-in. stock to such width that it will be a tight fit in the saw kerf. The key and the joint are then glued and drawn up with clamps. The resulting joint has almost double the strength of the plain miter, but it is stronger still if the key is cut with the grain running across it rather than the long way.

The rule joint *J*, Fig. 9, is almost universally used to join a drop leaf to a table top. It is simply an ovolo and cove molding, the ovolo formed on the edge of the top and the cove on the edge of the leaf. It is easily made with the aid of the power saw.

Square the joining ends and on 13/16-in. stock measure back from the end of the top 5/8 in. and square a line across both edges. Adjust dividers or a sharp pointed pencil compass to a radius of 9/16 in., set the point on the squared line 1/16 in. from the lower edge, and scribe an arc *a* from the squared line to the lower edge. Do this at both edges. Set the dado head to cut 3/16 in. in depth and ¼ in. in width, and bring up the rip fence to measure 5/8 in. from the side to the opposite edge of the cutters. Run the groove across the top; then trim the waste down to the arc with a plane, and sandpaper to a smooth contour, true with the arc.

For the leaf, set the dividers with the point as close to the edge as possible and 1/16 in. from the lower side of the leaf and scribe arc *b*. Set the saw table so that the blade cuts about ⅛ in. in depth and set the rip fence so that the cut will be just inside the arc, one corner of the kerf coming just to the line of the arc. Run this cut the width of the leaf; then lower the saw table and bring the rip fence about ⅛ in. closer to the blade and adjust the depth so that the saw kerf comes just to the line. Run the second kerf with the width of the leaf, and continue the cuts about ⅛ in. apart until the whole of the waste inside the arc has been kerfed with the saw, the corner of the kerf coming just to the line of the arc (see Fig. 6). It is then an easy matter to trim the waste to the line of the arc with a wide sweep gouge and sand the cove smooth with a piece of sandpaper wrapped about a length of dowel.

The hinges are mortised in at the bottom (*J*, Fig. 9), with the hinge pin centered on the line squared across the edges 5/8 in. from the ends.

The strong pin joint, *K*, Fig. 9, is useful in making small boxes and in drawer joinery. Set the dado head to cut the same depth as the thickness of the stock to be joined, and lay off pins and sockets of the same width on the ends of the same piece. Use the proper cutters of the dado to cut the required width; for example, if ⅜-in. stock is to be joined, set the dado to cut ⅜ in. in depth and lay out pins and sockets the same width. Mark the location of each pin and socket with lines squared back from the end. Cut half the sockets as shown in Fig. 7; then place the miter gage on the opposite side of the table and cut the other half.

The tongued or keyed radial joint *L*, Fig. 9, is necessary when building up a circular column. Trim the stock to the angle, then slot the edges at right angles to the face as in Fig. 8 for the keys.

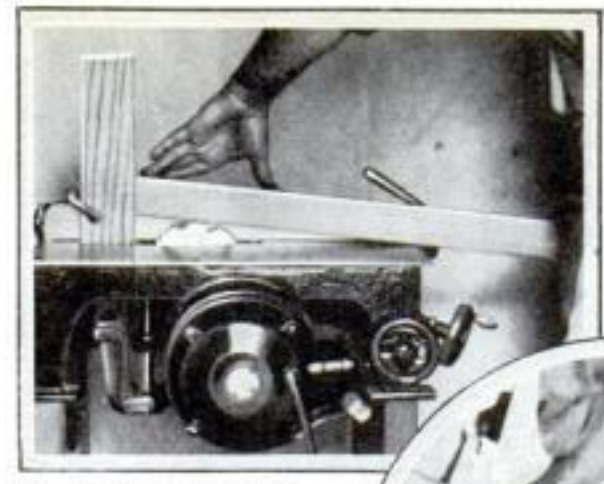


Fig. 5. How a mortise is cut. *Right:* Fig. 6. Cutting a cove for the leaf on the rule joint.

Above: Fig. 7. The work is held vertical in cutting a pin joint. The dado is raised to the desired depth of the pins.

Fig. 8. Slotting a radial joint. Note that the blade is square with table.

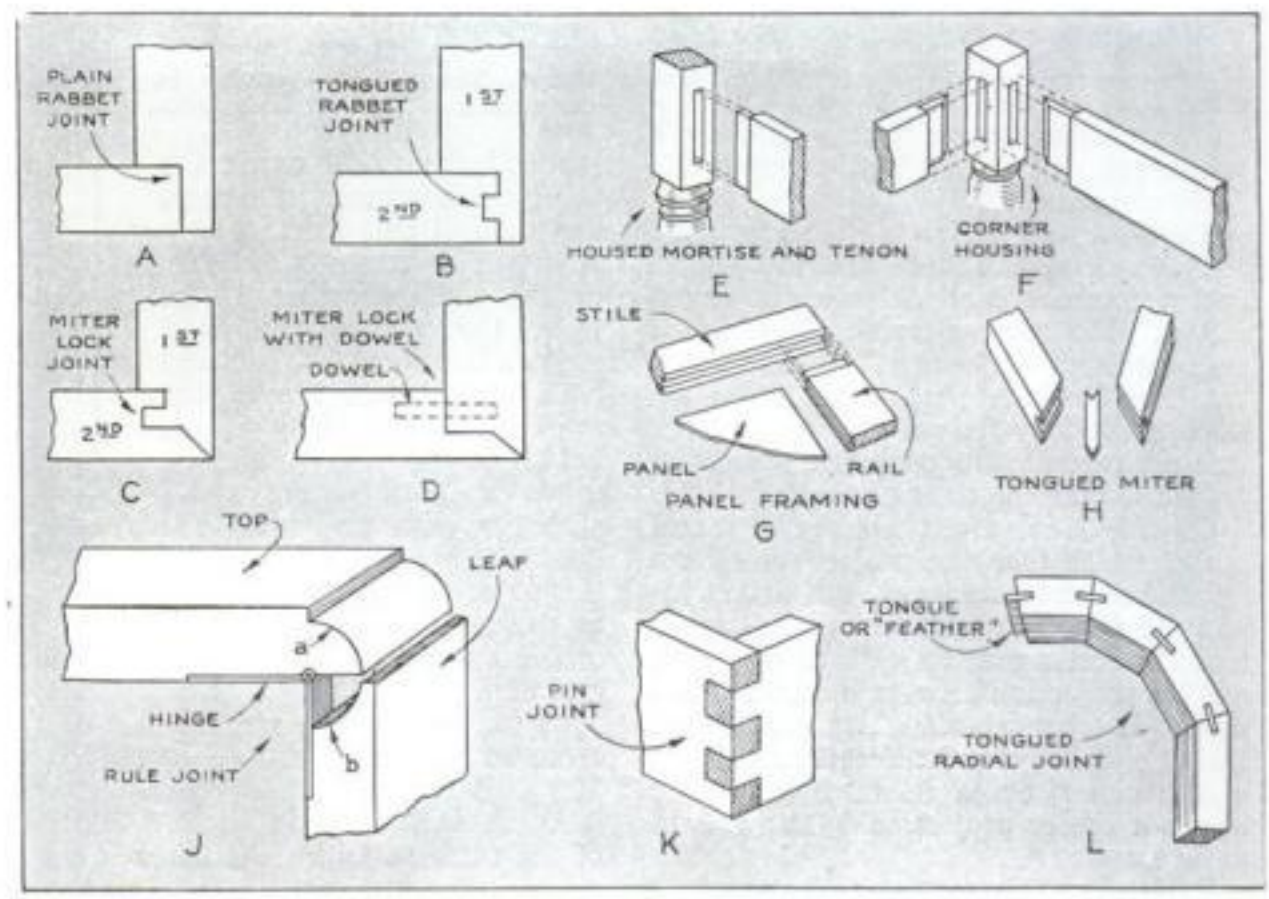
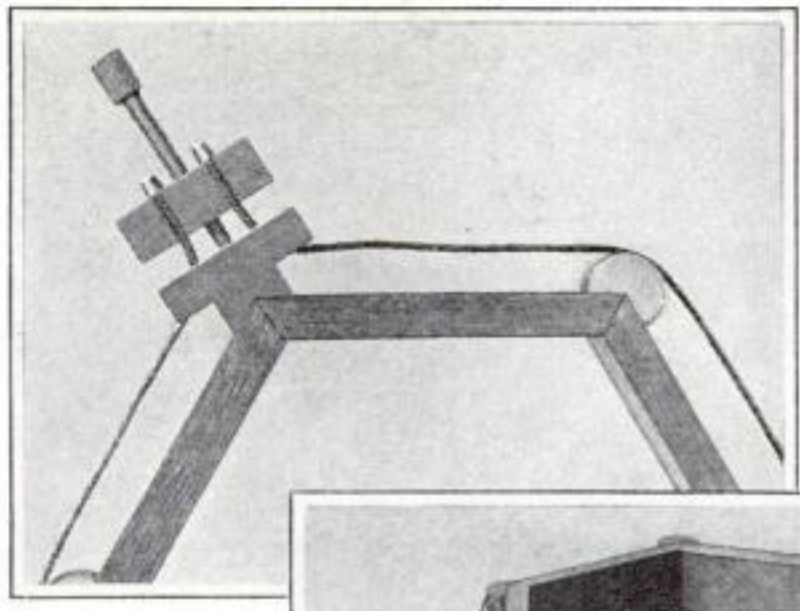
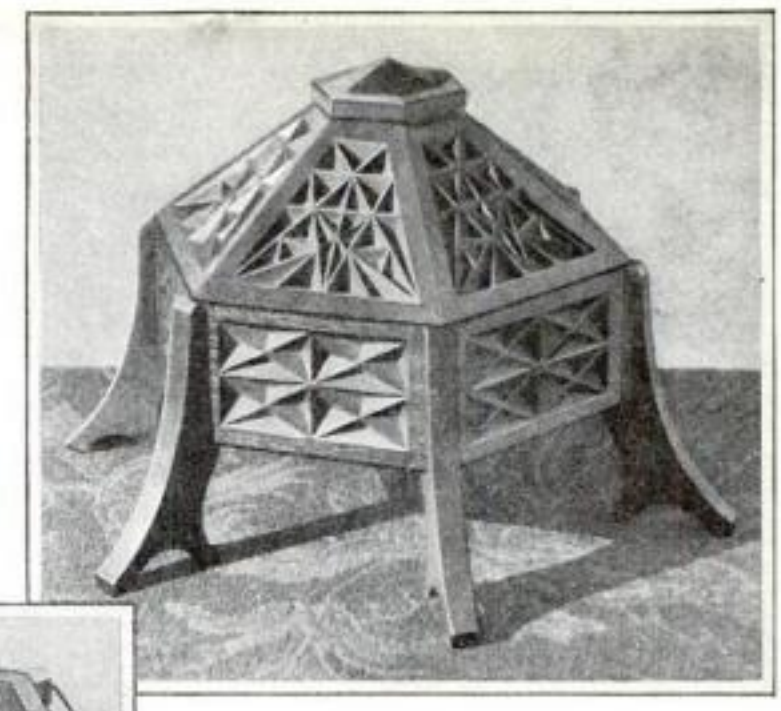


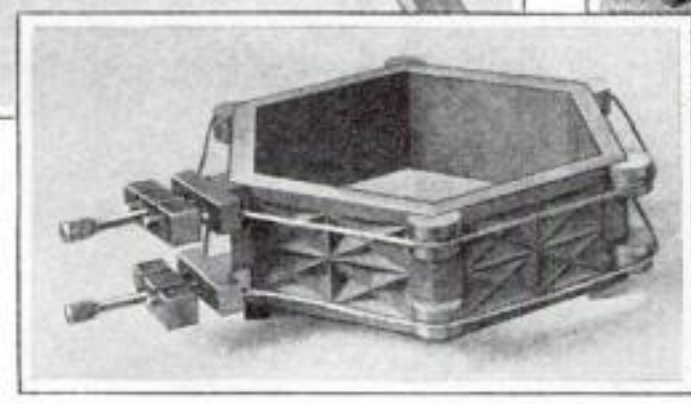
Fig. 9. Eleven difficult joints that can be made quickly and easily by the amateur who owns a motor-driven circular saw. Of course, these joints can be made by hand if necessary.

GLUING SMALL ODD-SHAPED BOXES



The method of using the gluing clamp is shown directly at the right. The box shown at the extreme right, which was assembled with the aid of such a clamp, was awarded first prize in a recent Canadian National Exhibition held in Toronto, Ont.





Two clamps were used in gluing the 2 in. high body together. The completed box is 7½ in. high overall.

MANY amateur woodworkers would like to fashion small, odd-shaped gift boxes of decorative and individual designs. This is not difficult to do. A miter box will give the correct angles for sawing the edges of pieces that are to form the sides of boxes with more than four sides; casein or other high-grade glue will fasten the joints permanently; and a clamp for holding the pieces in contact while the glue sets can be made as shown in the accompanying illustrations. This clamp was devised by my brother, W. F. C. Anderson, who makes wood carving his hobby.

The screw for tightening the rig is taken from a small C-clamp. The main outer block is of brass ½ by ½ by 1½ in., threaded, and with two small channels cut through halfway to receive the small wire cable. The inner block has slanting holes for the cable to pass through, and a depression for the tip of the screw; and for a six-sided figure the lower surface is machined at an angle of 120°. The other corner pieces are made from a ¼-in. round brass rod in which a 120° channel has been machined. With a hack saw this rod is cut in suitable sections, and in the round part of each a notch is sawed to keep the cable from slipping. Obviously, a similar clamp could be made for gluing boxes with any desired number of sides.

The clamp illustrated was constructed specially for a hexagonal box of a given dimension. The cable was therefore cut at the proper length and the ends dipped in solder to keep them from passing through the outer block of the clamp. For boxes of varying measurements, a small clamp should be placed on the cable to allow adjustment.—HUGH M. ANDERSON.

USES LIGHTHOUSE MODEL FOR WINDOW LAMP

This model of the Cape Hatteras lighthouse is 2 ft. high.

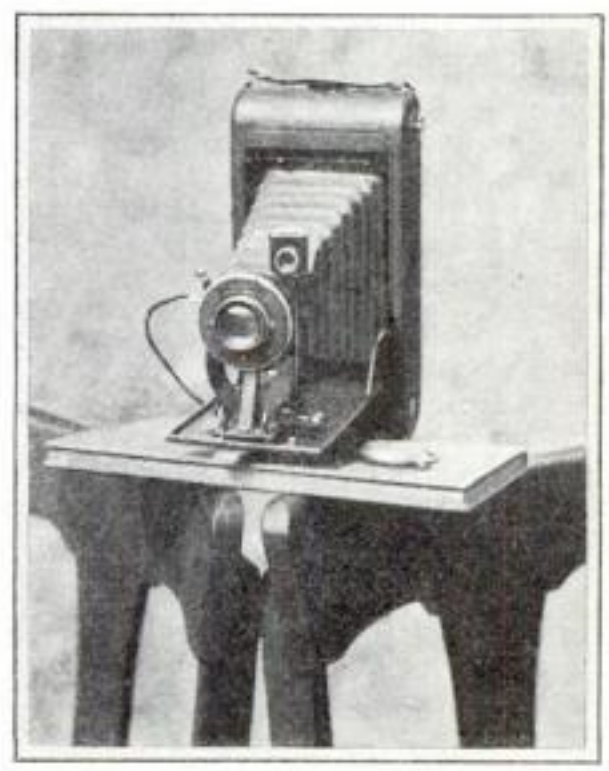
GUIDED by an illustration that appeared in this magazine (P.S.M., Dec. '30, p. 67), John Tabb, of Erie, Pa., built the realistic model of the Cape Hatteras (N. C.) lighthouse shown in the accompanying photograph. It is really a large electric table lamp. Mr. Tabb keeps it on a stand near one of the front windows in his home and uses a "flashing disk or button" in the lamp socket at the top of the main shaft to obtain a more striking effect at night. The model is constructed almost entirely of wood. The shaft is turned 4½ in. in diameter at the base, 2½ in. at the top, and 18 in. long. This rests on a built-up octagonal base. The glass top which incloses the bulb is a beverage glass of the many-sided or prismatic type. The top balcony and conical cap are of wood, the handrail stanchions are nails, and the handrail itself is fiber. The shaft of the lighthouse is painted in the usual "barber pole" fashion. Such a light could be used for decorative purposes in an informal garden.

OLD AUTO HORN BECOMES A FLOWER HOLDER

THOSE who take pleasure in making something useful from cast-off materials can easily convert a discarded auto horn —minus motor and housing—into an unbreakable, yet attractive, flower holder or vase. The horn may be left as it is or decorated as desired. The one shown in the illustration above was coated with liquid bronze, and a sprig of flowers was stenciled on in black. The color scheme, however, is largely a matter of personal choice. To make the vase hold water, a large cork is inserted snugly into the hole in the bottom. If the cork is not sufficiently water-tight, a little paint or melted paraffin run around the edges will solve the difficulty. If desired, felt can be glued on the bottom.—FRANK W. HARTH.

CHAIRS REPLACE CAMERA TRIPOD IN EMERGENCY

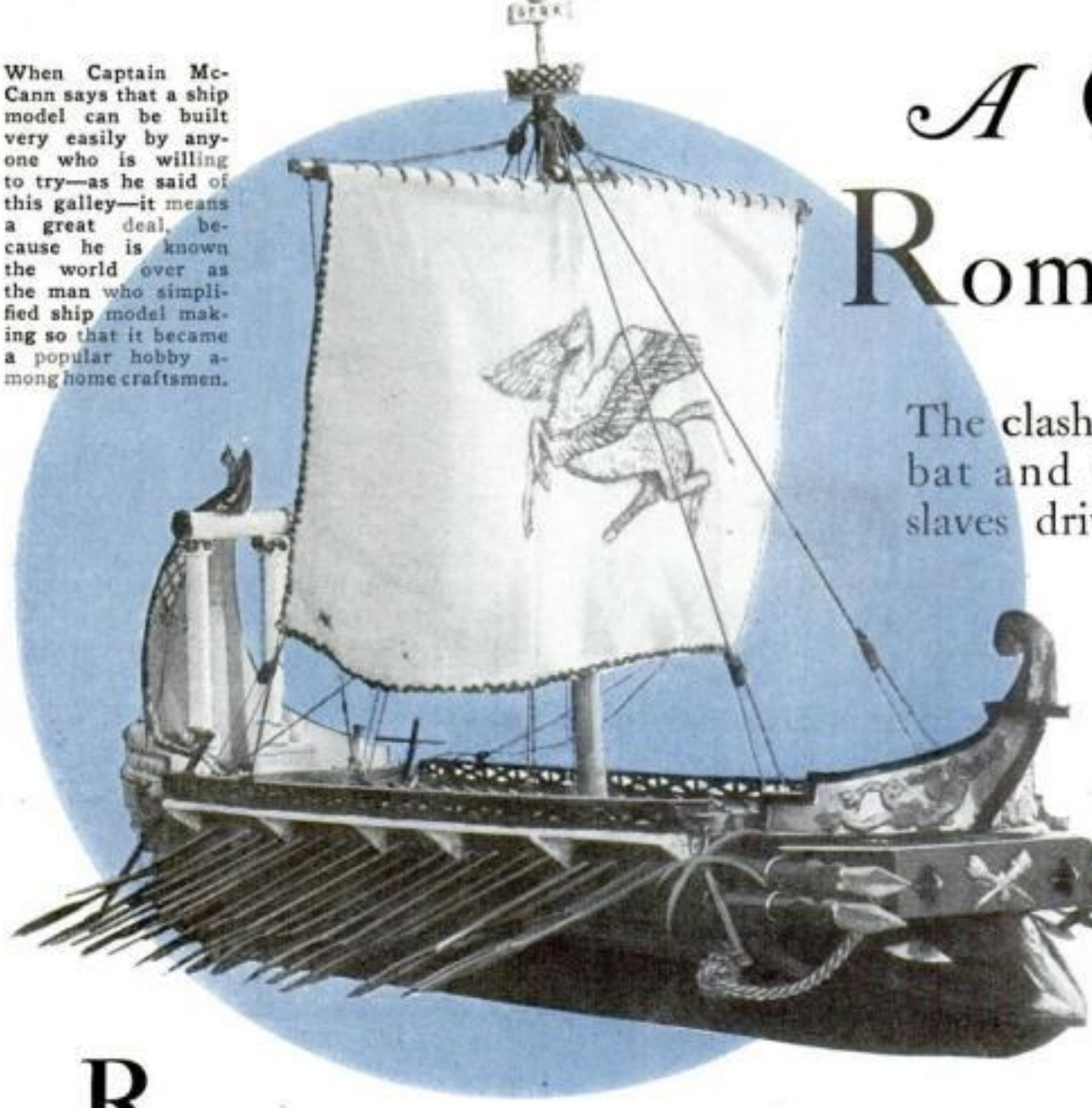
IF YOU take photographs—and in these days, who doesn't?—you are certain to be caught from time to time without a tripod when you wish to take a time exposure. Take two chairs of the same height and set them as shown so that the tops of the backs form an acute angle; then lay a book or any flat object on them to make a platform for the camera. Any convenient article can be slipped under the camera to tip it.—F. B.



A book or drawing board placed on the tops of two chairs serves to support the camera.

A Gorgeous Roman Galley

When Captain McCann says that a ship model can be built very easily by anyone who is willing to try—as he said of this galley—it means a great deal, because he is known the world over as the man who simplified ship model making so that it became a popular hobby among home craftsmen.



The clash of hand-to-hand combat and the groans of galley slaves driven by the lash once echoed from ships such as this—symbol of the power and glory of Rome.

To build this model you need very few tools, and you probably have most of the materials.

ROMAN soldiers went to sea at times in great, slave-rowed galleys and fought desperate battles with enemy fleets. They were led in action by a consul or general—there were no Roman admirals—on board a fast, richly ornamented galley which gleamed in brilliant colors and gilded carvings from prow to stern. Such a galley has been chosen as the subject for the new model in the POPULAR SCIENCE MONTHLY series of historic ships. It has the advantage of being very easy to make while at the same time it is unusual in design, colorful, and exceptionally decorative.

Most of what we know about the Roman galleys has been gathered from coins and sculptures and from some vague descriptions, amplified recently by many details found when the Emperor Caligula's galleys were retrieved from the bottom of Lake Nemi, Italy. All the available evidence has been studied and used in designing and constructing the model illustrated. It is not one of the largest galleys with built-up castles and heavy engines of destruction, but a large, speedy vessel such as might have been used by a consul or general.

These vessels were rowed with one or more tiers of oars. One tier *(unireme)* would be the easiest to make, but two tiers are more interesting. These make the model a *bireme*. A third tier may be added, which would turn it into a *trireme*. Beyond this it is not feasible to go; for while one reads of galleys having up to forty banks of oars *(tessaraconter)*, these probably were bargelike craft with that number of men to each oar.

We know that these vessels were brightly painted and well carved and gilded, but there are no records telling exactly how. This gives us considerable latitude to exercise our artistic talent in carving and painting our model, as long as we keep to conventional Roman ornament. Encyclopedias, histories, dictionaries, and other reference books often contain illustrations of Roman designs, and every large library or museum has informative material on this subject, should you wish to use more elaborate ornamentation than that shown.

To the scale of 1/6 in. equals 1 ft., a real galley 114 ft. long and 26 ft. in beam would be represented by a model of 19 in. length and 4½-in. over-all beam; with a height to the masthead of 12 in.

In building this or any other ship model, the one thing that is most likely to insure your success is to work from accurate, full size drawings. You can obtain these by sending 50 cents to the Blueprint Service Department of POPULAR SCIENCE MONTHLY for Blueprints Nos. 138 and 139 (see page 99). This is a very low price for blueprints that contain so much information and have cost so much to prepare—hundreds of dollars for the designing and drafting and for the printing plates. Before this mazagine set out to popularize ship model making, such blueprints as could be obtained from ship model dealers—and they were not simplified for beginners—were never sold for less than two or three dollars a single sheet and from six to nine dollars a set. You will, therefore, save yourself much work at a nominal cost if you make use of the Roman galley blueprints.

For the hull block *A*, obtain a piece of pine 1⅜ by 3¼ by 18¼ in. (or glue face to face two pieces of half that thickness). From the half-breadth plan (given full size on Blueprint No. 138) mark the outline of block *A* and the center lines. At the bow, mark the upper level *a* on the top of the board, and the lower level *a* on the bottom. Cut the wood away to these lines.

Now cut the ends to the lines shown on the sheer plan. Cut the lower corners to the line given in the cross section. Note that above the molding the curve is concave or gouged out, while below the molding the curve is convex. The cut running from the top to the curve of the ram is slightly concave.

From a piece 1⅛ in. thick cut block *B* with which the stern is built up. Its outline is shown at *b*. Shave this with a

slight curve to 5/8 in. in thickness at the forward end and glue it on; then cut the stern down in a series of steps to meet the main hull block *A*. Continue these steps as if they were moldings as far as shown on the sheer plan.

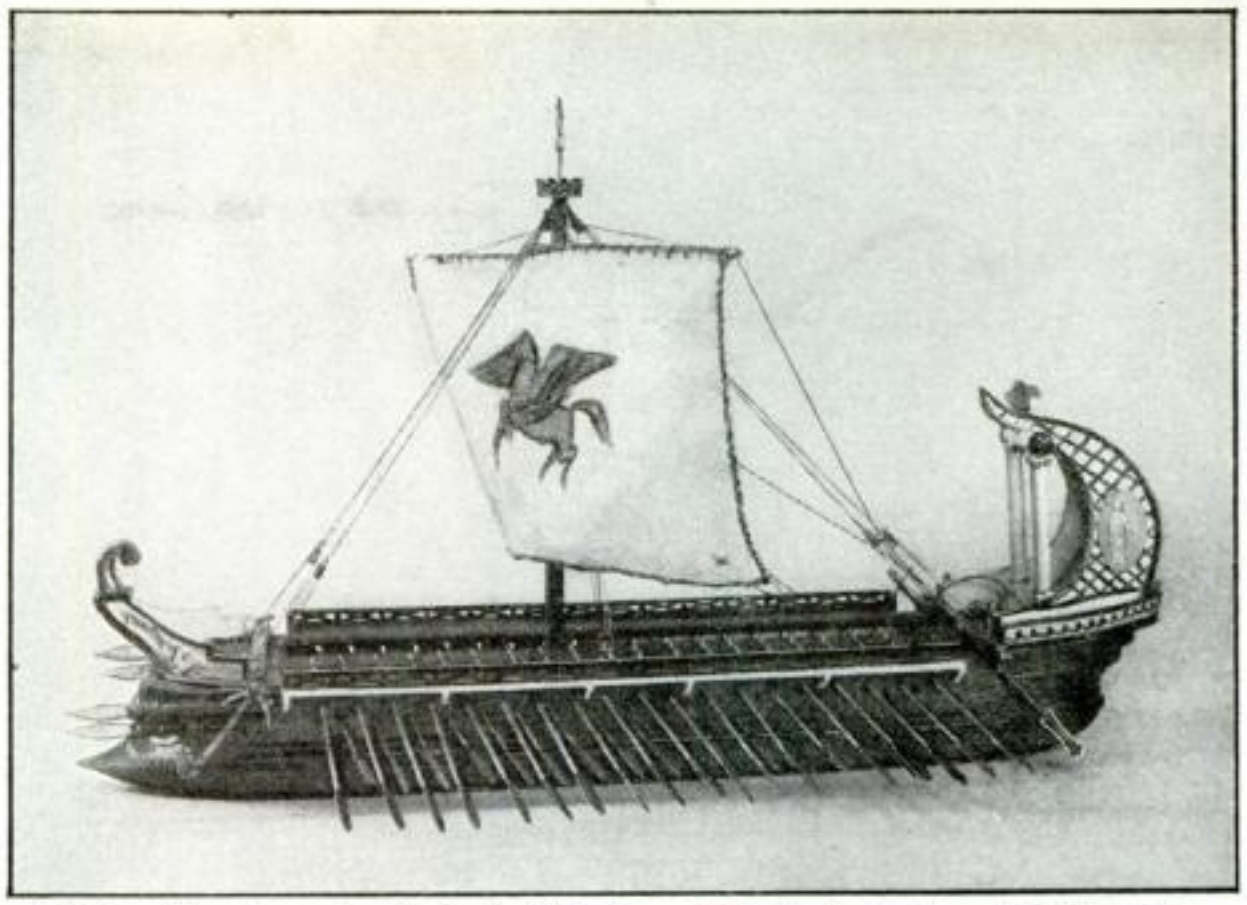
Cut another block, *C*, 5/8 in. thick to the lines *c* and glue this on the bow end. Notice that it projects beyond the upper level of piece *A*.

Prepare piece *D*, 5/8 in. thick and 7/8 in. wide, to fit tightly between *B* and *C* when glued along the center of block *A*. It will be about 11 5/8 in. long.

Run a molding as shown from the point of the horn along the upward slope, and another to meet it and go right around the stern. For this I used a square strip of chairmaker's spline, but thick braided fishline, celluloid, or pine will do. Steam the molding, if necessary, to bend it around the stern, or join it neatly there. Glue and nail it on with 1/2 in. long bank pins.

Now cut two strips of semihardwood or three-ply wood not more than 1/8 in. thick to the lines shown at *E* in the sheer plan; that is, to fit in the rabbet in *B* aft, to fit against the straight edges of *C* on each side, and to overlap the hull 3/16 in. The top edge of these pieces are level with *B* and *C*.

Before fastening on strips *E*, bore the holes for the oars. I made the holes 3/16 in. in diameter so that the oars would have room to work, but later I had to lash the looms (handles) to keep them in position. It would be easier to bore the holes as shown so as to fit the oars; then a touch of glue will hold them. If this is done, the holes will be the size of the oars and will, looking from the outside, point up and forward. I arranged the oars as if they had just been lifted out of the water at the end of a stroke, because that gives the model a forward moving look. How to make the oars will be told next month. Glue and nail pieces *E* in position and chamfer the forward end of each to agree with the angle of *C* (see the half-breadth plan).



While nothing short of a painting in full color could do justice to the model, this photograph shows how graceful and well proportioned it is and what an unusual ornament it makes.

The model will look almost as well if, instead of separately fitting in the long central piece and the bulwarks, you use a solid hull and make *B* and *C* in one continuous thickness of 5/8 in. from end to end, with a wedge-shaped piece glued on aft to give the rise and with the oar holes bored into the solid wood. If you do this, cut the large piece to the outside dotted line of the half-breadth plan.

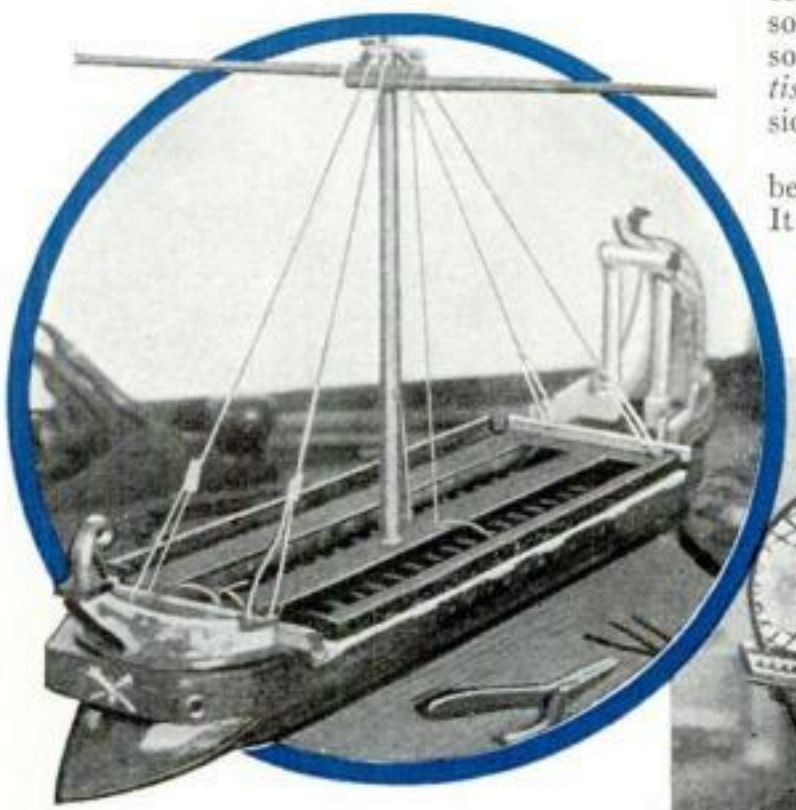
Whether the hull is solid or hollow, the deck will be the same, except that for a solid hull the center of the deck will not be cut out. Cut the deck from as thin wood or plywood as you can obtain and follow the outline given on the deck plan. Then, for a hollow hull, cut out the whole central rectangle indicated by the solid lines. Glue this to the hull so that the extended deck *(apostis)* is the same width on both sides.

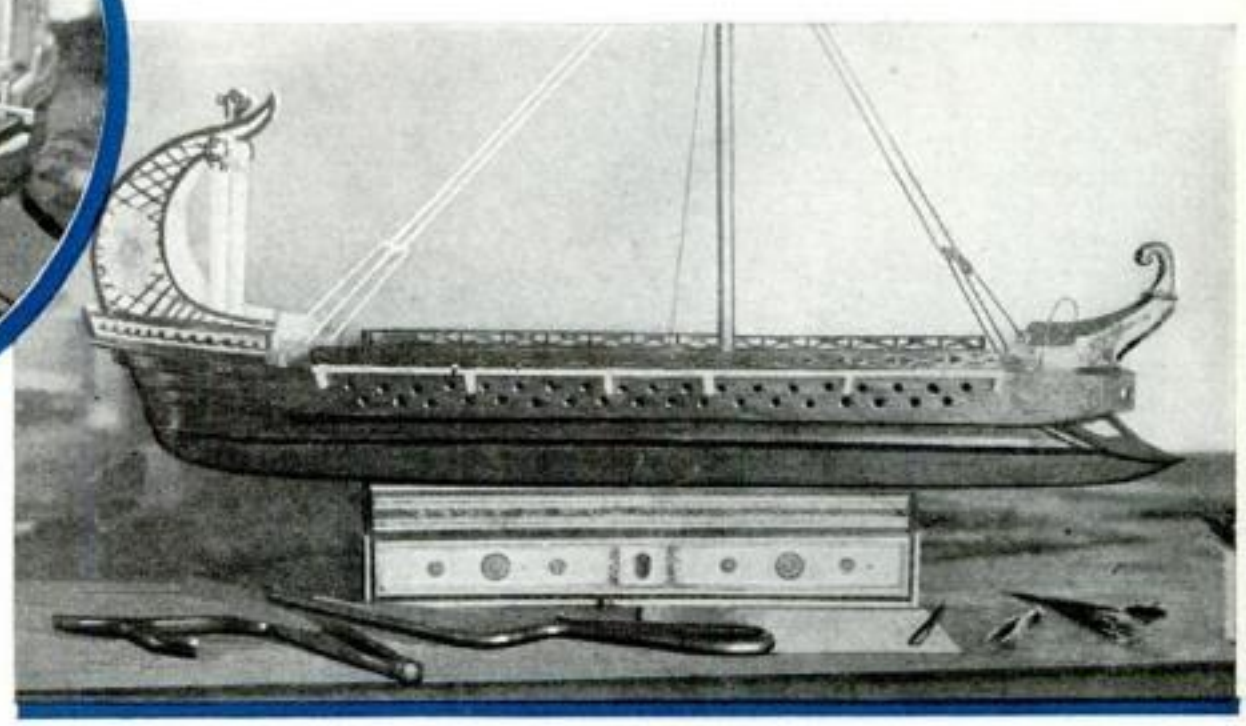
If your ship is to have rower's benches, they should go in next. It is easiest to do this if, before fastening the piece *D*, two saw cuts are made along it on each side at the heights indicated in the cross section. In these, glue strips of wood 1/8 in. wide and the thickness of the saw blade (say 1/16 in.). There will be one bench for each oar, each one a little forward of its respective oar hole. From hull block *A* to the outer corners of these, glue pieces of wood 1/8 in. square for posts (see cross section).

The *apostis* requires brackets to give the appearance of support on the outside, so I glued and nailed three-cornered pieces of wood at symmetrical intervals.

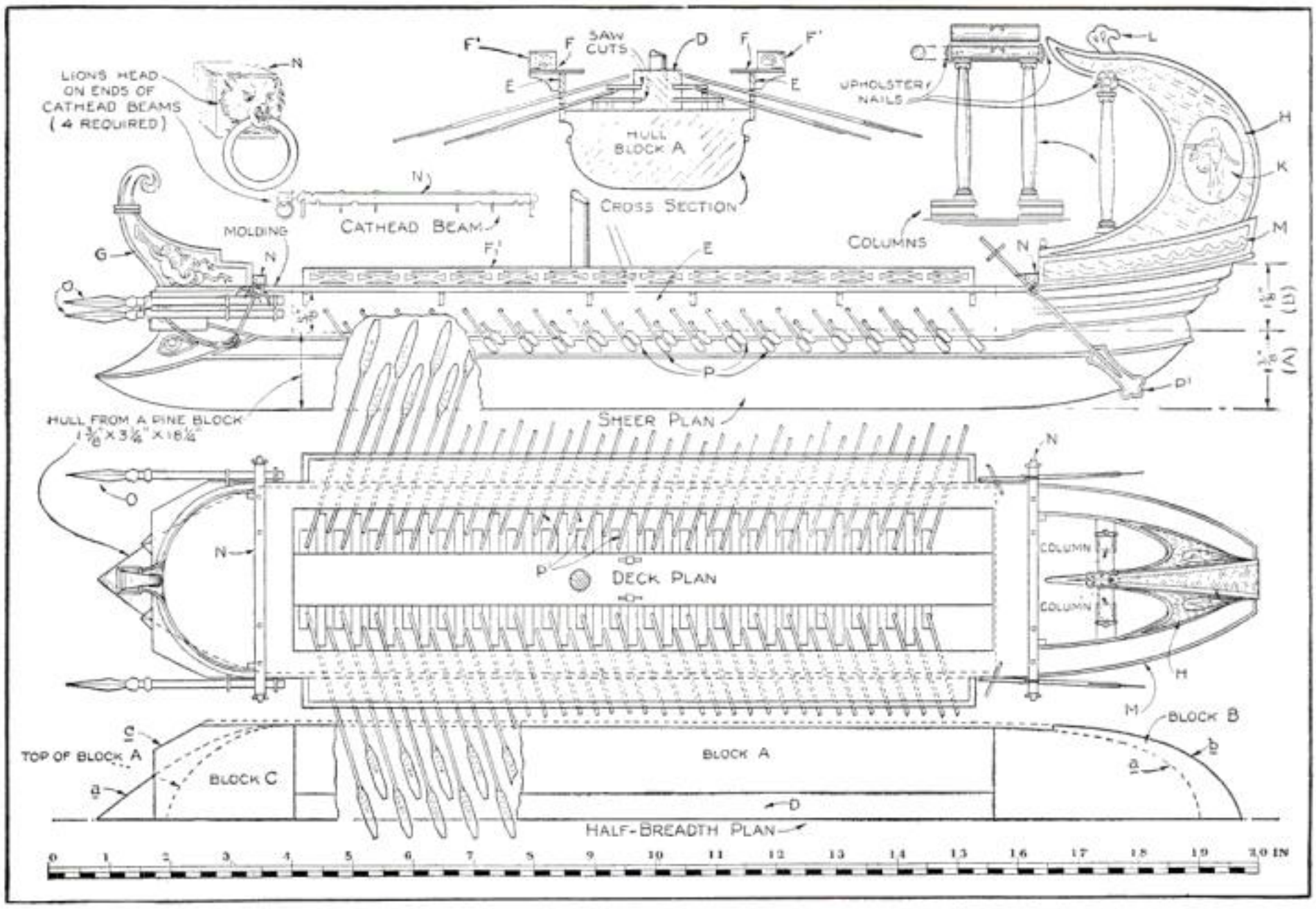
For the railings around the *apostis*, I used five-ply bristol board cut as shown in detail *F*, a flap being left to turn up and glue to the deck. The railings will look better if a strip of wood 1/16 in. square is glued along the inner edge at the top.

The inside of the hull and the benches are stained a light brown, and the deck a darker brown, with *thin* coats of varnish stain. The lower part of the hull also is stained brown, somewhat irregularly and with a trace of green added here and there. The remainder of the hull requires three or more foundation coats of flat white paint, rubbed down until a smooth, perfect surface is obtained. Spare





Above: A view looking slightly down at the hull from prow to stern. *At right:* Side view of the hull when well advanced toward completion. Compare the photographs on this page carefully with the drawings on the following page and on Blueprints Nos. 138 and 139 (see page 99). The blueprints show all parts full size, simplifying the construction.



Sheer plan or side view of the hull, deck plan and half-breadth plan, cross section, and details of cathead beam.

no pains in this work, for the finish is most important. The hull is then painted ultramarine blue up to the molding, and the bulwarks are colored purple. To get a brilliant effect, paint these parts with flat color a shade lighter than the final color, and afterwards give them a coat of artist's oil color.

The edge of the deck and brackets are left white, and the railing is painted a bright but not gaudy red obtained by mixing geranium red and light red. The top edge of the railing and molding are black.

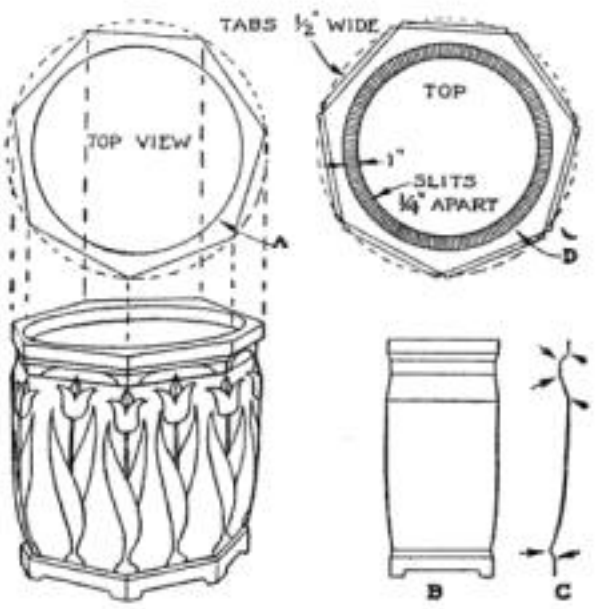
The superstructure, rigging, rail, and other details will be described next month.

Cardboard Jardinière Rivals Pottery

ALTHOUGH it has the appearance of being an expensive piece of pottery, the jardinière or flowerpot holder illustrated is nothing more than cardboard and paper. It is light and unbreakable, fits the flowerpot it is designed to conceal, and costs next to nothing. The materials are half a dozen pieces of cheap cardboard about 1/16 in. thick, a roll of gummed paper 2½ or 3 in. wide, a knife, several tubes of water colors, shellac, and varnish.

First draw the top on a sheet of cardboard as shown at *A*, making the inner circle ½ in. larger in diameter than the flowerpot. Then divide the outer circle into the desired number of sides; this will give you the width of the sidepieces at the top. Next draw a pattern for the sides as shown at *B;* the exact shape is not of especial importance. Cut out as many sidepieces as necessary and score straight knife cuts across them as indicated by the arrows in the edge view *C*. Complete laying out the top as shown at *D* by drawing a circle 1 in. inside the inner circle previously drawn and marking off ½-in. wide tabs on the outside edge. Cut out the top and bend down the tabs as indicated. Glue the upper edges

of the sidepieces to the long, narrow tabs; then turn the holder upside down and fasten the sides together with numerous small pieces of gummed paper stuck on the inside. Cut a number of ornamental shapes from the gummed paper—flowers, geometrical units, or what you please—and stick these on the outside. Also run a reënforcing band of cardboard around the inside edge of the top to cover the tabs, and bind the rim with gummed paper. Paint the outside with two coats of water colors. The best method is to work out a cloudy, marbled effect for the background. Apply a heavy coat of shellac; then flow on a coat of waterproof spar varnish.—JOHN J. DE VINK.



The assembled flowerpot holder and patterns for cutting the sidepieces and the toppiece.

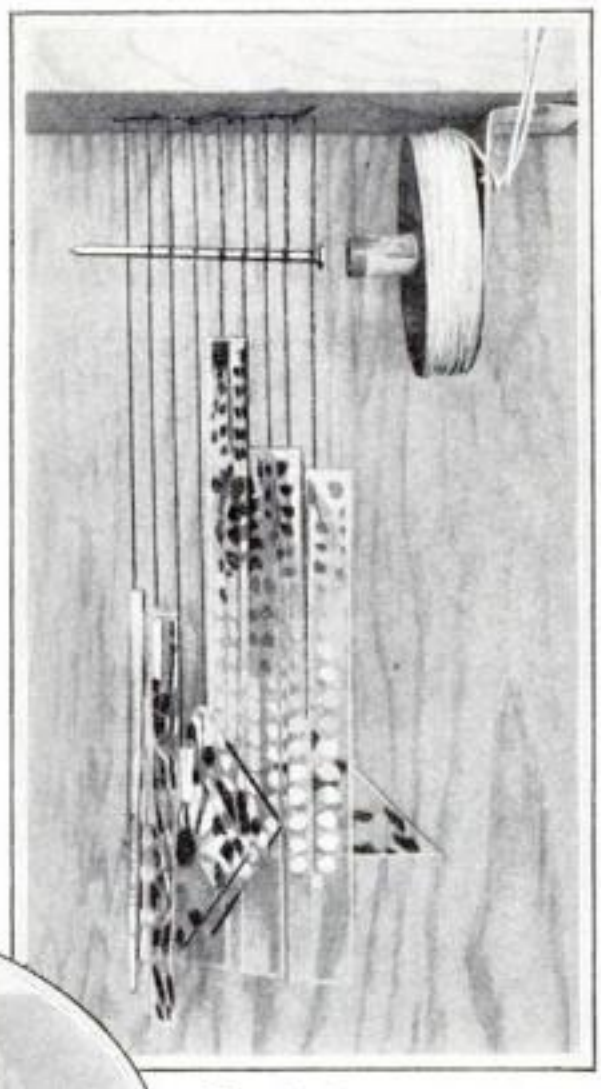
GLASS CHIMES FORM NOVEL DOORBELL

JAPANESE wind chimes, which consist of several pieces of thin glass and are sold for as little as ten cents, can be converted into a unique electric doorbell.

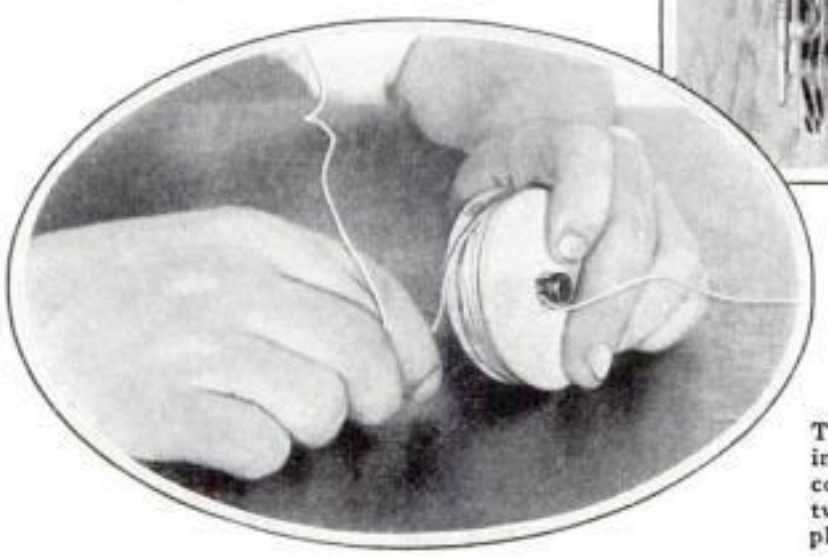
If a strong electromagnet is not available, make one by winding magnet wire around a soft steel core. The magnet illustrated is ½ in. thick and 2½ in. in diameter.

Fasten the magnet by means of an angle iron or bent piece of tin to the lower face of a block of wood. Cut a number of glass chimes from the original rigging and tack their strings in a row in front of the magnet, spacing the tacks about ¼ in. apart. Fasten a soft iron nail in loops made in the suspended strings so that the head is ¼ in. away from the magnet core. Mount the block in any convenient and inconspicuous location.

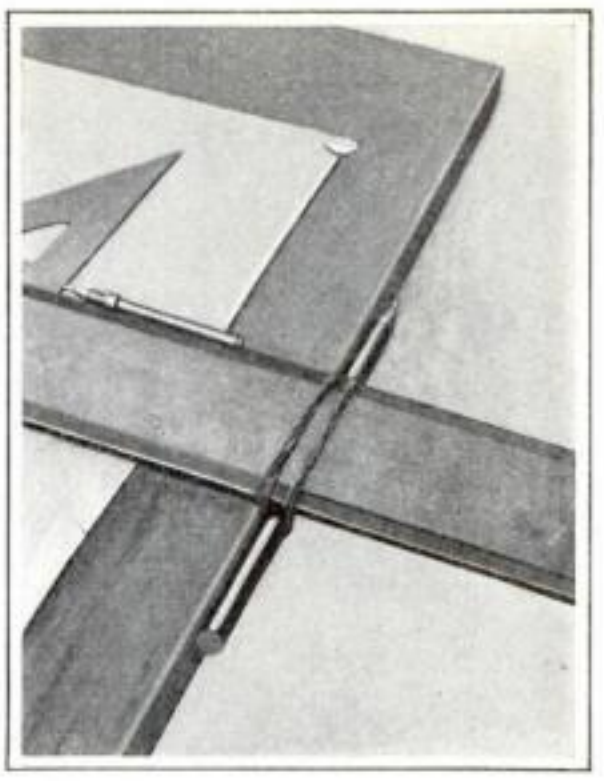
The wires from the magnet lead to a bell transformer or battery and to the bell button. When the doorbell button is pressed, the magnet draws the nail-head forward with a snap and sets the glass tinkling.—K. M.



How the Japanese wind chimes are arranged. When the magnet is energized, the nail is pulled quickly to the right, setting the glass chimes tinkling.



The magnet can be made by winding magnet wire around a soft iron core. The wire is wound between two cardboard disks. When completed, the winding is shellacked.



PENCIL STEADIES END OF LONG T-SQUARE

MECHANICAL drawings must often be laid out, especially in the home workshop, on a sloping drawing board which is much shorter than the T-square used with it. The right end of the square has an annoying tendency to slip down. While there are, of course, various excellent devices available to steady this end of the square, a practical substitute can be made as shown from a lead pencil and a strong rubber band. By occasionally drawing the fingers over the band towards the left, the pencil can be kept in strong contact with the edge of the board, yet the square can be moved freely up and down the drawing board. It is best to use a new, unsharpened pencil as it will be smoother and longer, presenting a better bearing surface.—FRANK W. BENTLEY, JR.

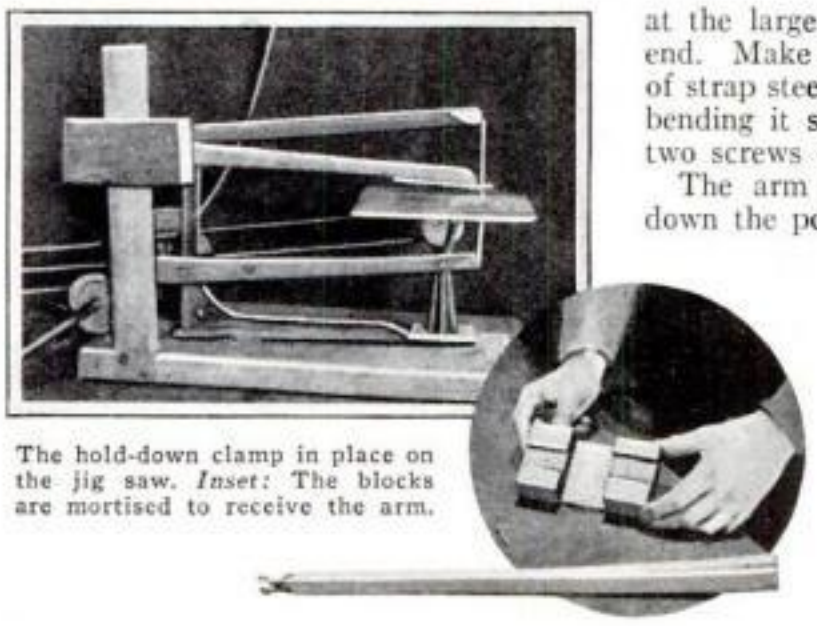
SHELLAC BRUSH KEPT SOFT IN JAR CAP

A mayonnaise jar and a tire valve dust cap form this container.

TO KEEP a small quantity of shellac, brushing lacquer, or enamel in good condition and the brush soft and ready for instant use, punch or drill a ⅜-in. hole in the screw lid of a glass jar, such as a discarded mayonnaise container, and solder a tire-valve dust cap over the hole. This will make it possible to leave your brush in the liquid so that it will not become stiff or need to be cleaned each time it is used; and the painting material will also remain in a fluid, usable condition instead of becoming tacky, as it does when not kept in a tightly closed container.

Since a brush should not be allowed to rest on its bristles, it is well to wrap cord or tape around the handle so that it will stay in place when pushed up into the dust cap.—C. E. P.

WOODEN HOLD-DOWN IMPROVES JIG SAW



The hold-down clamp in place on the jig saw. *Inset:* The blocks are mortised to receive the arm.

Low priced jig saws rarely have a hold-down to keep the saw from lifting the work on the up-stroke, but one can be made from wood without difficulty.

Into a base of suitable size—mine is 2 by 6 by 22 in.—fasten an oak upright 1 by 2 by 16 in. in the position shown, using a strongly mortised, glued, and screwed joint. Lay out the hold-down arm on a piece of 1 by 2 by 18 in. hickory or other very tough wood. It should be slightly bow shaped, about 1 in. square at the large end and ¾ in. at the other end. Make the presser foot from a piece of strap steel by filing a notch in one end, bending it slightly, and fastening it with two screws on the underside of the arm.

The arm holder which slides up and down the post is made of three pieces—two blocks 1⅛ by 2 by 3 in., one of which goes behind and the other in front of the post, and a piece of plywood 3 by 6 in., which is screwed to the flat sides of the other two pieces in such a way as to hold them 2 in. apart—the width of the post. The two blocks are mortised on the side opposite the plywood to receive the arm at a slight angle. This should be done in such a way that the assembled holder and arm will fit the post snugly.

Place the saw on the base, line it up with the arm, and fasten it. To adjust the hold-down for any thickness of stock, merely raise the sliding arm holder, slip the work under the foot, and press down on the holder. The pressure at the tip of the arm makes the holder pinch the post tightly. To release the arm, slide up the holder.—LE ROY VAN TASSEL.

Hints *of* Value *to* Auto Workers

Automatic Adjustment of Generator

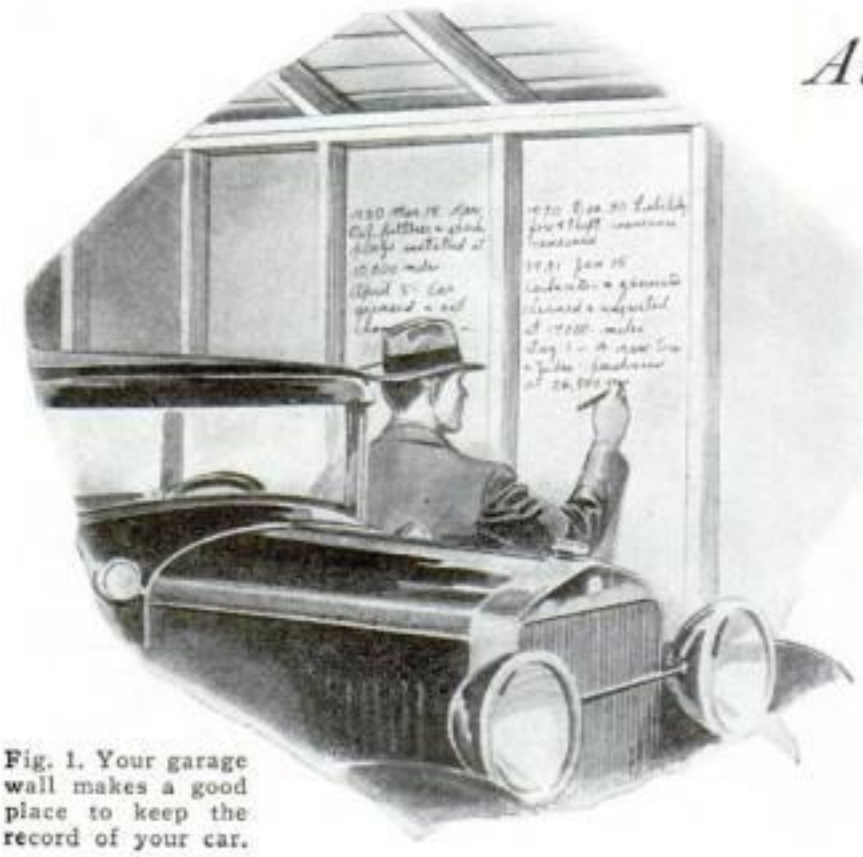


Fig. 1. Your garage wall makes a good place to keep the record of your car.

KEEPING a record of the various service and repair jobs that have been done on your automobile is, in theory, a relatively simple job. All you need is a small notebook in which to enter the various items. In practice, however, it doesn't work out that way. Being out of sight, the notebook is forgotten and the record is neglected until it is useless. What you need is a record that will be constantly in sight to act as a reminder to make entries when the jobs have been done and also to indicate when additional service operations are needed. If you keep your car in your own private garage, the walls of the garage form an ideal place for the car's service record. Or you can pin up large sheets of paper.

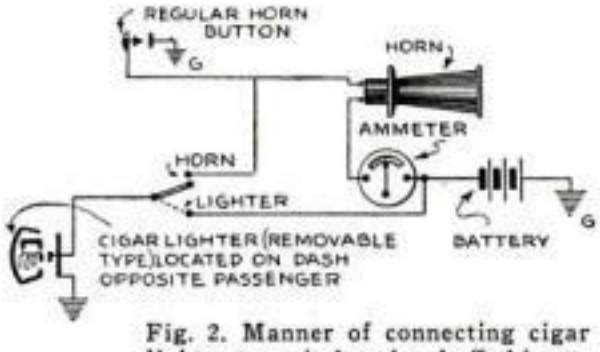


Fig. 2. Manner of connecting cigar lighter to switch to head off thieves.

THE removable type cigar lighter is a convenience, but the fact that it is easily removed may result in its loss, especially in public garages.

If the lighter is wired as shown in Fig. 2, no one will steal it. Instead of connecting the wire from the cigar lighter to the battery cable back of the ammeter, the wire is attached to the movable contact terminal of a two-way switch as shown. One of the remaining switch terminals is connected to the battery cable back of the meter and the other terminal is connected to the wire leading to the horn button at any convenient point. When the switch is thrown to the horn button side, a pressure on the cigar lighter will blow the horn and the heating element in the lighter will not glow.

WHEN a car is run far in daylight several days in succession it is common practice to reduce the generator charging rate. However, when such use is alternated with night trips, no single setting of the generator charging rate gives the proper results. Figure 3, below, shows a way out of the difficulty. By the use of an extra generator cut-out, wired as indicated, the charging rate is automatically cut down in the daytime and automatically put back to full charge at night. Only the fine winding on the generator cut-out is used and the fixed resistance should be set to allow about five amperes to flow when the generator is set for ten or twelve amperes, the usual charging rate.

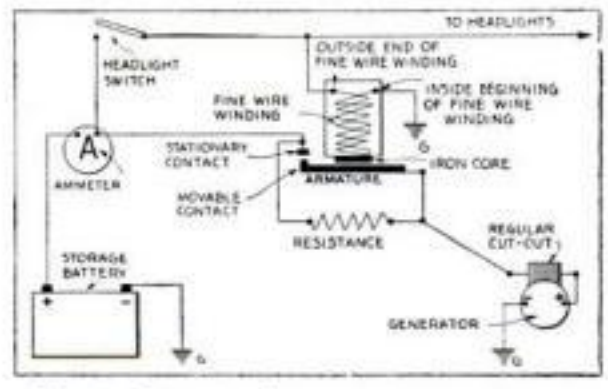


Fig. 3. By use of an extra generator cut-out charging rate is automatically changed.

AN excellent way to work out an electrical method of signaling left and right turns is shown in Fig. 4. The idea is to mount two lights, one on each mudguard, in such position that they can be seen from both front and rear. Each light is wired to its own steering wheel button. Red arrows against a black background could be used instead of lettering.

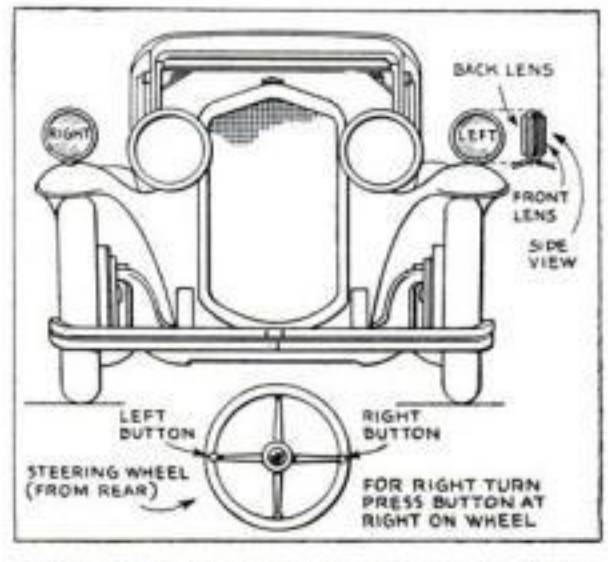


Fig. 4. Lights on each mudguard, wired to button on steering wheel, signal turns.

WIN A $10 PRIZE

Each month we award $10 for the best idea sent in for motorists. This month's prize goes to Emil J. Novak, Omaha, Nebr. (Figure 3). Contributions are requested from all automobile mechanics and if published will be paid for at regular space rates.

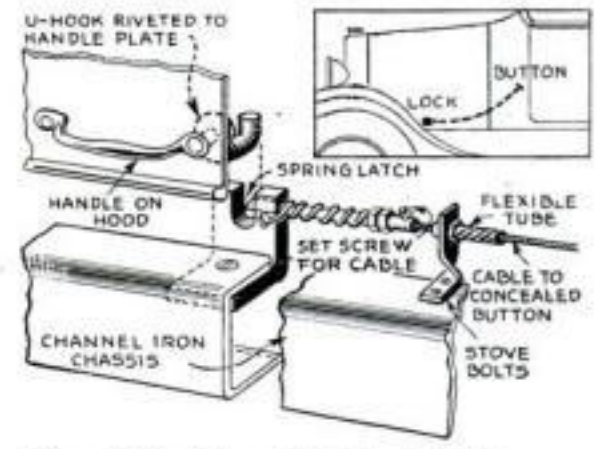


Fig. 5. By this method hood latches can be put on your car with operating buttons concealed under cowl but within reach.

IT IS often desirable, when the car is put in a public garage, to fix things so that no one can lift the hood and monkey with the engine. Figure 5, above, shows a simple way to add hood latches which can be operated by concealed buttons located under the cowl, one for each side of the hood.

The latch blocks are made from ⅜ by 2 inch bar iron bent to a right angle, slotted for the hooks and drilled for the latches as shown. They are bolted to the frame of the car. The U-shaped hooks are bent from bolts and are held by the bolts that are used to attach the handles to the hood. The latches are made of ¼-inch stock beveled so that the hook will snap into place when the hood is lowered into position. The release buttons can be mounted either underneath the dash or on the dash.

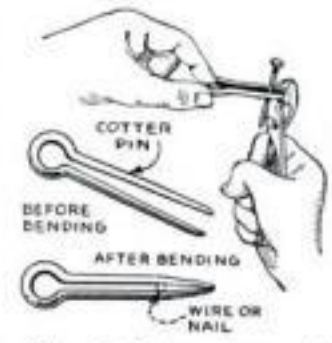
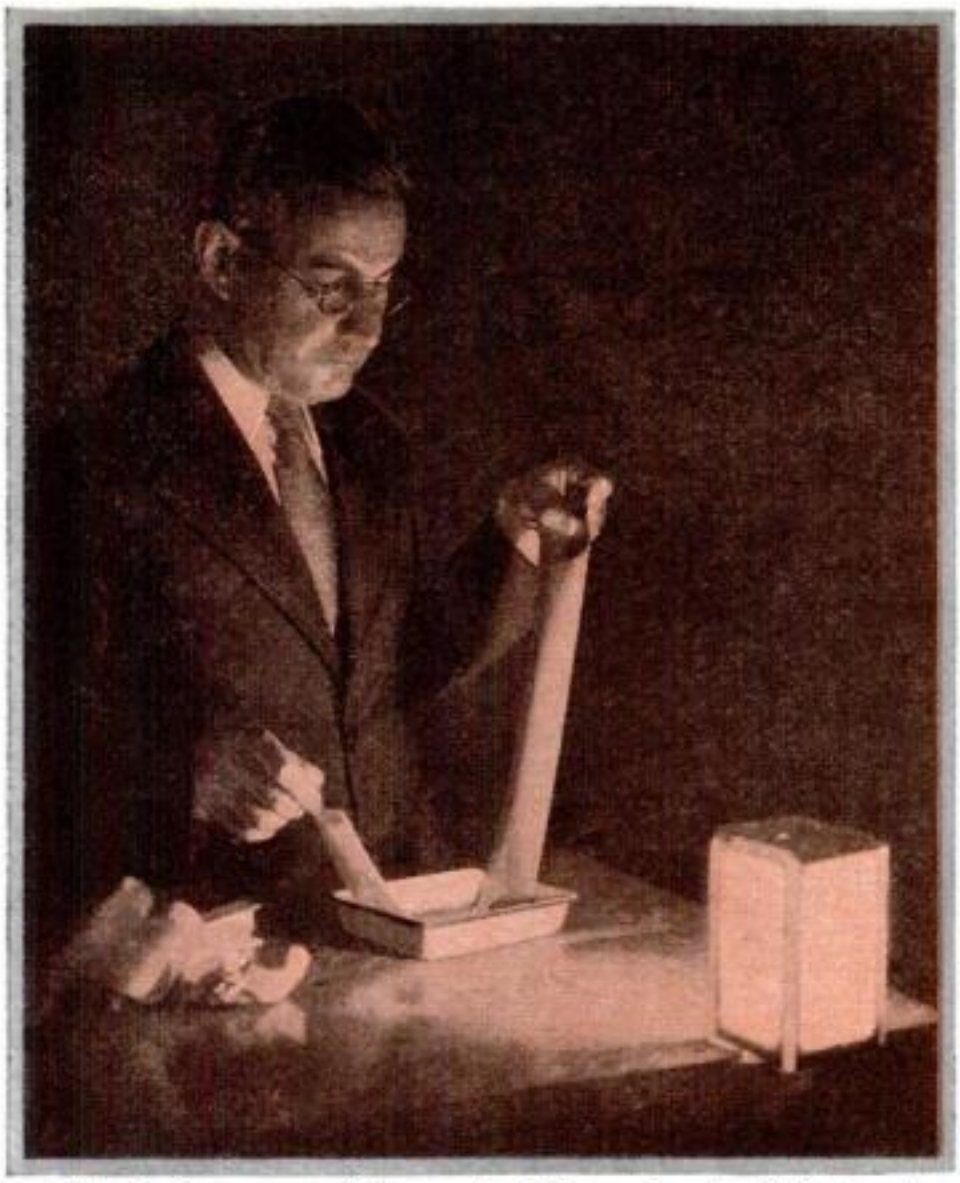


Fig. 6. Cotter pins can't slip out if nail is put between the split points.

AN EASY way to fix cotter pins so they may be slipped into tight holes is shown in Fig. 6. Place a nail or small piece of wire between the split points and squeeze the tips together with a pair of pliers as shown. This method is especially useful when the cotter has to be pushed into a hole hard to get at.



How to Do YOUR OWN

Developing

The work is easy and the results better than you obtain from some "hurry-up" professional finishers

By FREDERICK D. RYDER, JR.

Developing your own films requires little equipment. Perfect work can be done with just what is shown at the right—thermometer, trays, dark-room lamp, developing powders, and fixing salt.

"TAKE a look at these," said a friend of mine, handing me a bunch of photo prints. "I'm disgusted. I've taken enough pictures this summer to paper a room, and each roll is worse than the last. Do you think there is something wrong with my camera?"

The pictures certainly were poor. They were about as dull, gray, and uninteresting a lot of snapshots as I've seen in a long time.

"There's nothing wrong with your camera," I told him, "and there isn't anything much wrong with the way you use it, either. The trouble seems to be in the finishing. Probably the film was developed in stale, worked-out developing solution, and the printing is bad—look at the thumb marks and stains!"

"Well, anyway it's a relief to know it isn't my fault," he said more cheerfully. "If the finishing is to blame, I guess there's nothing I can do about it."

"WHY don't you look up a better photo finisher?" I asked. "Or develop your own films even if you have somebody else make the prints. If it isn't right, the printing can be done over again, but if the film is spoiled that means good-by to the pictures."

"I don't know enough about chemistry to develop films," he replied. "I'd probably spoil them all."

"Spoil them!" I echoed. "If you have sense enough to stir the sugar in your coffee, read a thermometer, and tell time by looking at a clock, you can develop films much better than the poorer photo finishing establishments."

"And I don't have to know any chemistry?" he asked doubtfully.

"Not a bit. You buy the developer already prepared either in powder or concentrated liquid form—fixing salts the same way. All you have to do is mix them with the right amounts of water. Full directions are on the package."

"What have the thermometer and the clock got to do with it?" he asked.

I explained that developing films or plates or film packs is a chemical action, and like all chemical actions, it depends on temperature and time. Furthermore, if the strength of the developing solution and its temperature are always kept the same, the time required to develop a film will remain constant. Knowing the importance of maintaining a constant developer strength and temperature is the first secret of successful development so far as the amateur photographer is concerned.

The second secret is to stick like glue to one brand and type of film or plate and one brand of developer.

THERE are hundreds of different developers. They are all capable of giving perfect results, but they differ greatly as to the strength of solution and the time needed to get results. Furthermore, the action of the various developing chemicals varies with the type of plate or film used. Obviously, when success depends on getting your developing procedure completely standardized, experimenting with different chemicals only postpones the day when you can guarantee yourself a perfectly developed negative for every film that you expose.

My friend, after I had convinced him that he could successfully develop his own film, wanted to know what apparatus he needed. I suggested that he put a good photographic thermometer at the top of his shopping list.

From that point on, the amateur will have to decide for himself what he wants.

In the right-hand photograph at the top of this page is shown the simplest possible equipment that is capable of perfect work. It consists of a thermometer at one dollar and a quarter, two glass or enamel ware trays costing thirty to sixty cents each (soup plates can be used instead of trays), a half dozen tubes of developing powder costing five cents a tube (one tube will develop two or three six-exposure rolls if done one after the other), a half-

Nine Simple Rules Insure Success

Use freshly mixed developing solution each time.

Always mix the developer to the same strength.

Use a thermometer and keep developer between 62° and 65° F.

Always develop your films or plates the same length of time.

Use acid fixing solution and renew it frequently.

Fix films for twice as long as it takes for yellow to disappear.

Wash them for half an hour in running water.

Hang to dry in a cool place where the air is circulating.

Thoroughly wash trays or tank as soon as the job is finished.

pound carton of acid fixing salt costing thirteen cents, and a folding, candle-type dark room lamp that costs a quarter.

While tray development requires the least equipment, it must be done in a dark room and it calls for a certain degree of manual dexterity. A wet film is about as easy to handle as a slimy eel, so the beginner is quite likely to spoil pictures with finger marks and miscellaneous scratches.

I strongly recommend tank development instead of trays for the amateur. The photograph at the end of this article shows a standard type of roll film tank, a film pack tank, and a tank that can be used for plates, film pack, or cut film. Tank prices range from two to eight dollars depending on the type, the size, and the material of which the tank is made. The chief advantage of tank development is that it permits you to standardize your development procedure to the last degree and therefore insures perfect results. But the fact that no dark room at all is needed for roll film tanks and a dark room is needed only to load the tank shown at the right in the group is a worth while feature.

Complete information for manipulating each type of tank is furnished by the maker, so it is not necessary to go into details on this point.

Because it works very rapidly, metol-hydroquinone developer is popular for tray development. For use in tanks, there is no choice between the ordinary tank powders, also called pyro powders, and the concentrated liquid developers of the rodinal type. The liquid developers are, of course, quicker to use because there is no waiting for powders to dissolve.

Here's a Chance for You to Win $10

POPULAR SCIENCE MONTHLY will pay $10 for the most photographically perfect picture submitted on or before October 1, 1931. It may be of any subject, but must be taken during the months of August and September, 1931, by an amateur and developed by himself. Any type of camera may be used, and the printing may be done by a professional.

Mail both print and negative to Photographic Editor not later than October 1, and mark your entry "September Photo Contest." If you wish the print and negative returned, send a self-addressed, stamped envelope with entry.

While it is possible to develop films with the developing solution at temperatures up to seventy-five degrees Fahrenheit, do not use a developing solution temperature above sixty-five degrees if there is any way to avoid it.

When the temperature goes above sixty-five degrees, the film surface becomes very soft and is easily injured. In winter there is no trouble in keeping the solution down to that temperature. In fact, on cold nights you may have to add hot water to keep up to sixty-five degrees. In hot weather, use ice to get the solution down to the proper temperature.

Determining the length of time to develop your film, either in the tray or in the tank, is easy if you maintain a standard developer strength and temperature. For your first attempt, try five minutes in tray development or twenty minutes with the tank. If your negatives give prints that are dull, gray, and lifeless, increase the time of development about twenty percent on the next roll and keep on increasing it till you get clear prints.

If, on the other hand, you find your first roll gives harsh prints, cut the time twenty percent.

How to make your own prints will be Mr. Ryder's topic in the October issue. Meanwhile, he will be glad to criticize prints provided they are accompanied by the negatives and a self-addressed, stamped envelope; and he will also answer any questions on photographic matters.

The whole secret of the three tricks lies in the fact that 1/32 in. is trimmed from one end of the jack of clubs. If the pack is then "riffled" close to the ear as shown above, a slight snap will be heard when the short card passes by, and this indicates where the pack should be cut to reveal the unknown card.

THREE MYSTIFYING CARD TRICKS REQUIRE NO SLEIGHT OF HAND

THESE three tricks, to parody a magician's patter, are "simply startling" and "startlingly simple."

The only preparation required is to obtain a deck of cards with borderless backs, remove the jack of clubs, and trim off 1/32 in. from one end with a photographer's trimming shear. Then round the corners with scissors so neatly that the card will look exactly like the others in the pack.

Place the jack on top of the deck and ask someone to choose a card. Have him return it to the top of the pack (which places the chosen card over the jack) and cut the deck a number of times. Now "riffle" the cards close to one ear, and there will be an audible snap as you riffle past the jack. Cut the cards at this point and show the bottom card of the top half, which, of course, will be the card chosen.

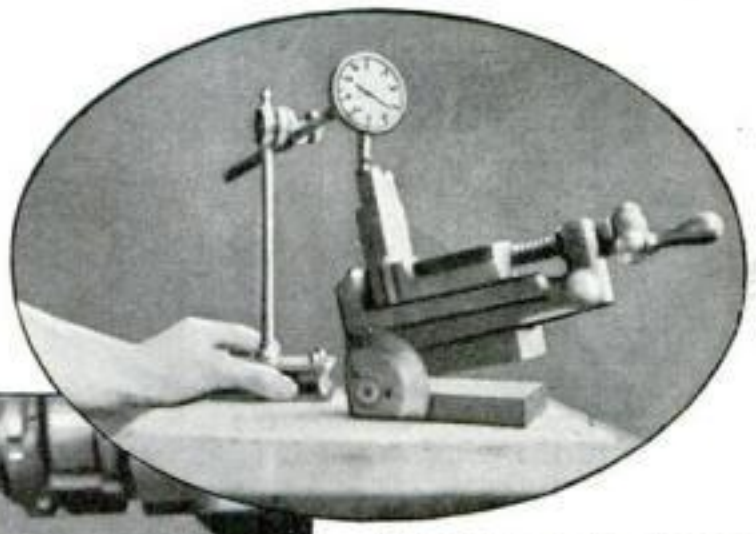
In the same way you can pick out the chosen card with the deck held behind your back. Simply grasp the cards at the ends and cut them. The cut always takes place easiest at the shortened jack.

Place an ace over the jack, have the cards cut as much as is desired, and with the deck on the table you can always cut to an ace. If a spectator tries it, he will be naturally inclined to grasp the deck at the sides when cutting the cards, and there is little chance that the secret will be revealed.—KENNETH MURRAY.

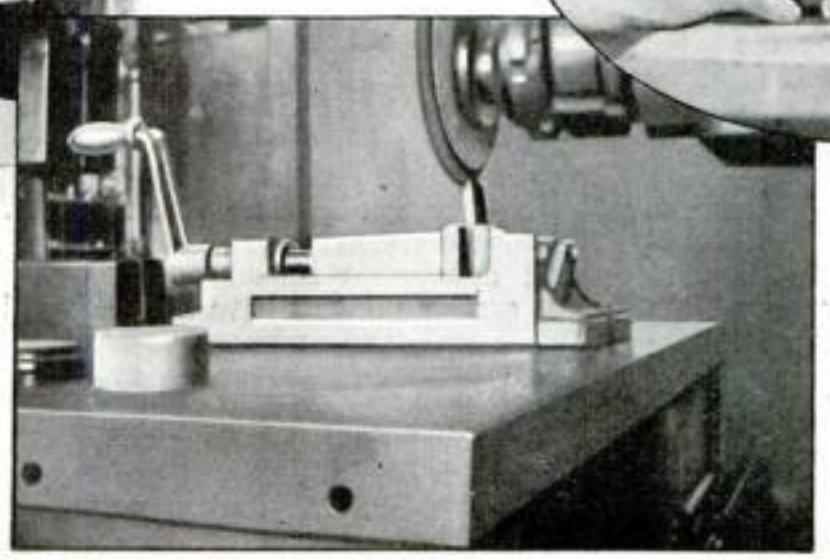
Hints on Grinding Form Tools

By HECTOR J. CHAMBERLAND

Fig. 1. Two Acme threading tools can be ground to identical shapes with the fixture shown at the left. The construction of the fixture is shown at the top of Fig. 4.



Above: Fig. 2. Any drop or step on the forming tool can be accurately measured with an ordinary dial indicator.



At left: Fig. 3. By forming a double angle on the grinding wheel, a threading tool can be quickly brought to the desired shape. The tool should be roughed to shape by hand.

IN THE small shop where low cost of production is an all-important factor, a great saving of materials and labor can be effected by shaping forming tools on the surface grinder rather than in the miller. A comparison of costs such as that outlined in a recent issue (see P. S. M., Aug. '31, p. 85) shows conclusively that the grinding wheel offers the most efficient and economical means for bringing small forming tools up to shape.

Where the flat type of forming tool is in general use the mechanic in a small shop can make even a greater saving by designing a shorter tool and using it in the interchangeable tool holders illustrated in Fig. 5. Of course, in the case of tools over 2½ in. in width tool holders would not supply sufficient support, but on the smaller tools they are an economical convenience. The money saved through the use of less material for each tool can be used to buy a better grade of stock. Forming tools to be used in holders should be ½ to ¾ in. thick and should be ground all over.

Forming tools with a lowest step or drop under ⅜ in. can be rough ground entirely without a preliminary roughing on the shaper. Take for instance the tools shown in Fig. 5; these can be rough ground to within 1/32 in. of the outline and then finish ground after the wheel has been re-dressed to insure sharp corners. In grinding the smaller tool in Fig. 5, a double angle was formed on the wheel and both angles cut at the same time. For the larger tool the angle was formed on one face of the wheel and separate cuts taken.

Threading tools can be made quickly with the grinding wheel. For a plain tool of this type, a double angle is formed on the wheel as in Fig. 3. Roughing the tool first by hand will prevent overheating in finishing. The tools are held in a vise at the proper angle and are finished in one setting. For Acme threading tools, the twin fixture illustrated in Figs. 1 and 4 is the best suited. This type of fixture can be designed to hold ordinary threading tools or tools with a special angle. The flats of the tools should be kept perfectly concentric by removing the same amount of stock from each side. After grinding one side, reverse the tools and finish the opposite side by adjusting the handwheel to the previous reading.

The exact thread size can be obtained by grinding the flats to fit the gage. The middle slot on the fixture is used to hold the tool during this operation. Acme thread tools thus ground are identical all over including the length. These can be fitted to a holder as in Fig. 4 and are interchangeable.

In shaping plain radius forming tools, which are common in most shops, we find that a ¾-in. full radius is the largest that can be made with the face of the surface grinder wheel. Of course, a portion or segment of a much larger circle can be made regardless of the width of the wheel. To obtain a full convex radius from ¾ in. up to 1½ in., the circular type of tool shown in Fig. 4 will be found the most economical. Holders of various sizes can be made for these tools. Allowing .015 in. for grinding, these tools are bored, faced, and turned in the usual manner. By reducing the rake on a

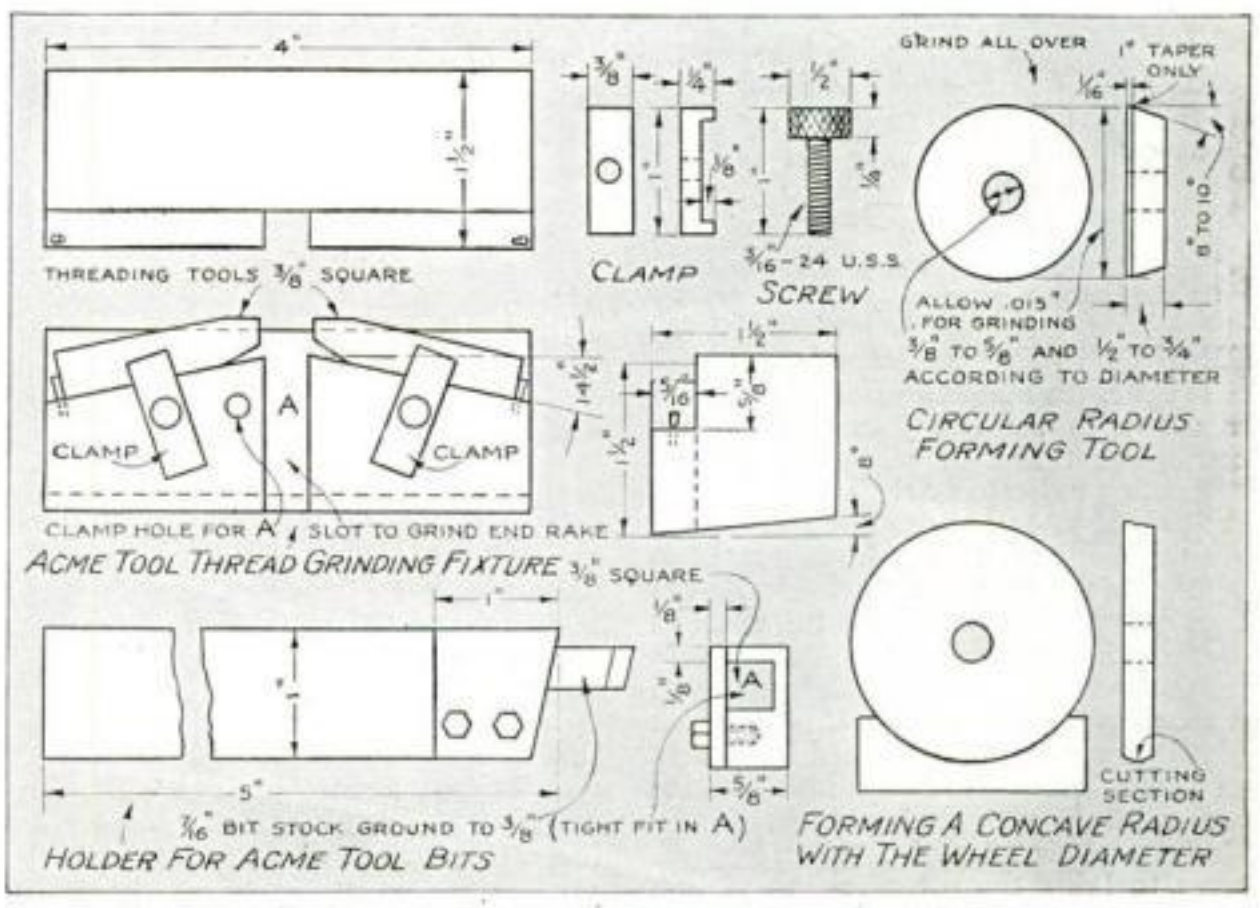


Fig. 4. How the fixture for forming threading tools is constructed; a holder for a threading tool; a circular radius forming tool; and how concave radii can be formed.

width of 1/16 in. of the cutting edge, the life of a radius tool can be lengthened, since it will allow repeated grindings without causing any appreciable difference in the diameter. Within the range specified, these forming tools can be made as outlined cheaper than in the miller. However, when the radius is large, making it inadvisable to use the above type of tool, the tool should be of the usual design—formed with the radius milling fixture. The tool may be as small as ¾ in. in diameter.

When a full concave radius over ¾ in. and up to 3½ in. is required it can be shaped readily in the miller with a cutter ground to the desired diameter. The tool may be finish ground by utilizing the diameter of the grinding wheel.

It should be borne in mind that a wheel on the surface grinder can be accurately dressed with a diamond to any size by using the graduations on the handwheel to obtain the measurement. As only a few thousandths need be removed in finishing the form tool, the diameter of the wheel is not materially affected in the process. Measurements should be taken on the grinding wheel with a micrometer whose contact points are protected with paper. Of course, all measurements must then be corrected for the paper thickness. A step can be measured as shown in Fig. 2.

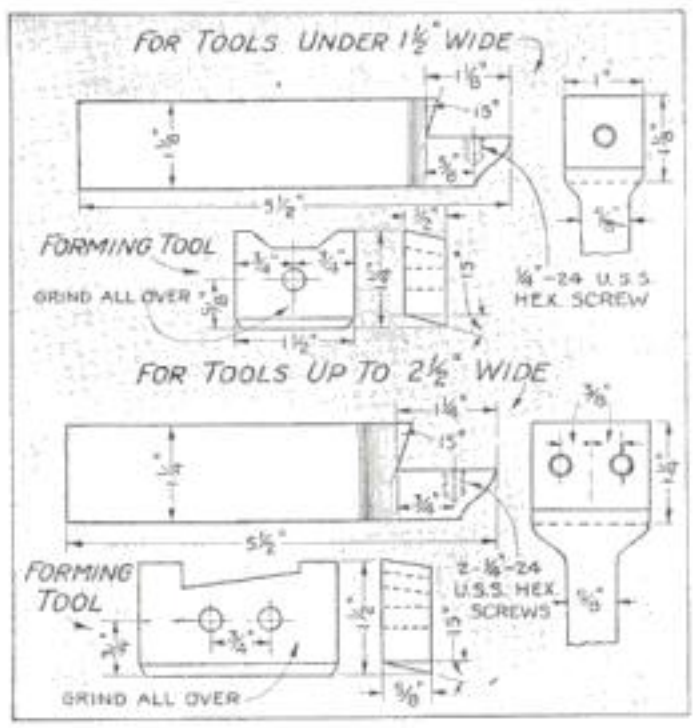


Fig. 5. Interchangeable holders for forming tools. Holders should not be used on tools over 2½ in. wide.

When shaping a grinding wheel under 3½ in. in diameter, the extension or high-speed attachment should be used. As most surface grinders have a capacity of 7 in., a wide range of concave radii can thus be obtained. As shown in Fig. 4 only about ⅛ in. of the surface of the wheel should do the cutting. For this operation a 46 J wheel will prove very satisfactory. By cross-feeding very closely and taking a cut of not more than .0005 in. a smooth accurate cut can be obtained.

Old Bill *Says...*

BAKELITE is best drilled with a drill ground to start through the bottom before the full diameter begins to cut on the top surface of the work.

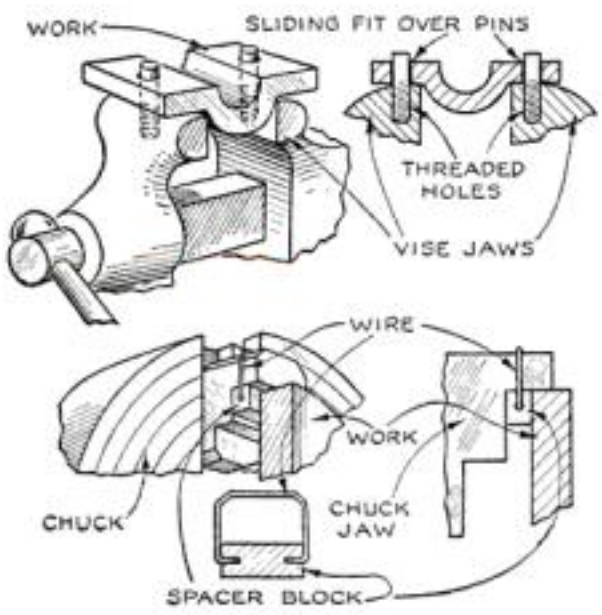
Keep your splining tools .001 in. undersize; it is a safe way to maintain a perfect fit for the key.

A milling machine vise, rotated by hand, will serve in an emergency as a rotating table for the milling of contours.

A designer or draftsman can increase the volume of his work with less labor if he will take the time to make up small celluloid templates for fillister, flat- and roundhead screws, and all similar details that are used again and again in his drawings.

If a reamer is ground correctly but cuts oversize it is a sign that the machine is out of alignment. The reamer should be relieved towards the back end sufficiently to compensate for the error.

TWO TIMESAVERS FOR MACHINISTS

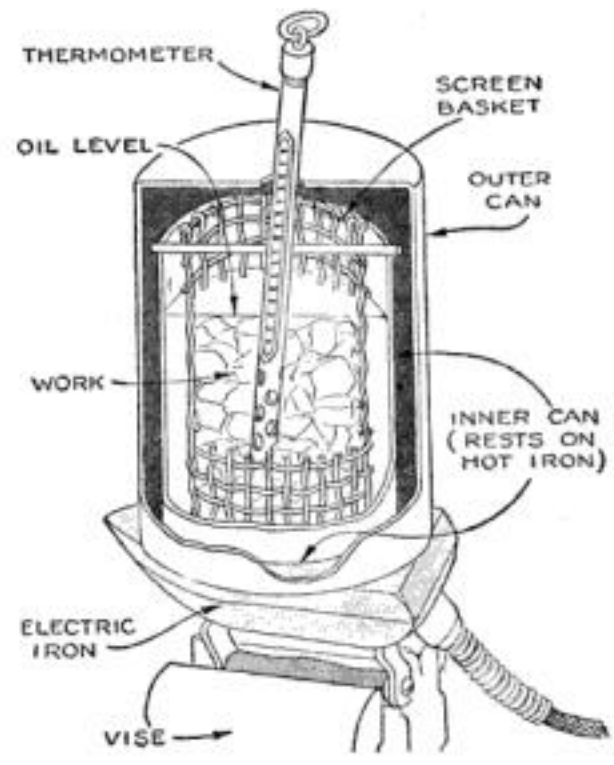


Removable pins on the vise jaws and blocks for the lathe chuck prove to be timesavers.

IN SHOPS where considerable vise work is done, the addition of removable pins as shown to the vise jaws will prove a convenient timesaver when working on connecting rod caps or similar pieces having two or more holes. The pins, which are made a neat sliding fit in the holes of the piece of work to be held, are threaded at one end and the top surfaces of the vise jaws are tapped to receive them. This allows the pins to be removed when they are not needed. Another kink which the writer has found useful in machining flat plates in the lathe are the spacer blocks also shown above. These blocks are placed under the work and serve to bring the outer surface of thin stock beyond the tops of the chuck jaws. The blocks are made rectangular in cross section so that two adjustments as to height can be obtained by merely turning the block from one edge to the other. Bail wire, bent to the shape shown and set in small holes drilled in the ends of the blocks, serve to hold the blocks against the jaws of the chuck while the work is put in place.—R. H. KIDDLE.

ELECTRIC IRON HEATS TEMPERING BATH

A UNIQUE and efficient heater for tempering small hardened steel tools such as punches and dies can be made from an ordinary electric iron in the manner illustrated. The electric iron is held bottom up in a vise and a tin can or other similar metal container two-thirds full of quenching oil is placed on top of the iron. The parts to be tempered are held in a basket made of wire mesh hanging in the oil. A length of steel rod passed through the mesh of the basket and allowed to rest on the edges of the can will serve to support it. Another can is placed over the top of the oil container and serves as a hood to keep in the heat. A hole is punched in the top of this can to take a thermometer, the lower end of which rests in the wire mesh basket. By allowing the iron to heat for about forty minutes, a temperature of 425° can be reached (equal to a straw temper). Such a device has been in use in one shop for three years and has proved entirely satisfactory. The tools, being drawn very slowly, are given a tough temper.—S. A. ASQUITH.



FOR very small work it is sometimes necessary to have a lap of such a diameter that it cannot be split with a jeweler's saw in the usual way. Simply file a flat on the lap to almost half its diameter. The flat will carry the abrasive and the other half will do the lapping.—F. J. W.

LUFKIN CRESCENT Tape-Rule

FIRST PRACTICAL COMBINATION *of the* UTILITY *of a* RULE *and the* ACCURACY *and* CONVENIENCE *of a* POCKET STEEL TAPE.

The CRESCENT is made of steel, but goes around a pipe as easily as a cloth tape would.

At the right - - - measuring two dimensions of a chair.

FLEXIBLE
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STURDY • COMPACT
AUTOMATIC WIND
CHROMIUM PLATED
CASE
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The CRESCENT Tape-Rule is a general purpose 6-foot measure. It is just the thing not only for mechanics in the building trades, etc., but also for the many thousands of others who measure, from executives, engineers and salesmen to factory workers and to amateur mechanics.

Back of the CRESCENT are the experience and reputation of The Lufkin Rule Co., leading manufacturers for 48 years. The LUFKIN trade-mark has long identified the best in Measuring Tapes and Rules.

72-inch CRESCENT Tape-Rule Marked inches to 16ths. **No. 696**

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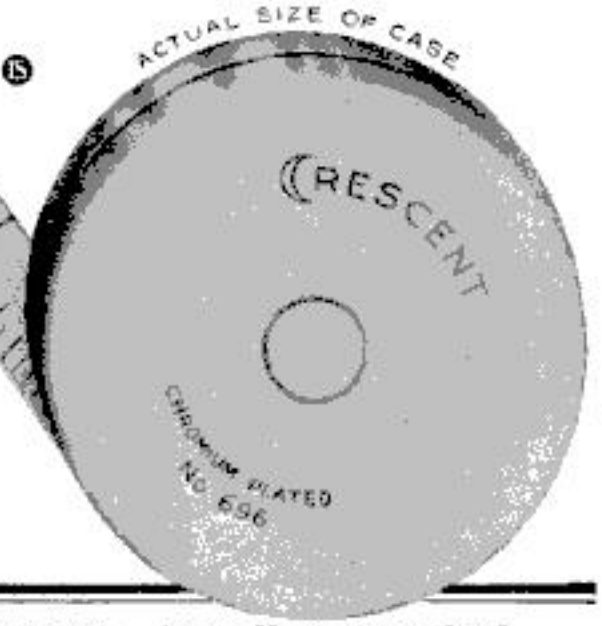
Also made in engineers measurement, feet, 10ths and 100ths of feet—CRESCENT No. 696 D.

Stands Upright—and yet measures circular and odd-shaped objects

RULE BLADE—Of tempered steel, stiffened by special forming. May be projected unsupported to wall or ceiling or into openings. At the same time, like usual Pocket Steel Tapes, it will flex around circular and odd-shaped objects. It is 5/8" wide, nickel plated, with prominent dark markings and figures, easy to read. It has a clip or hook at first end. This is primarily intended for withdrawing rule blade from case, but it will also hook over or on to objects out of arms reach, and thus is most handy for taking such measurements horizontally, vertically, perpendicularly or at any angle. Rule blade is manually withdrawn, automatically returned into case.

CASE—Sturdy, chromium plated, with rounded edges, compact, handy to carry. (Only 2 inches in diameter). Automatic-wind with ratchet stop, operated by push button. Simple and quick to operate, yet rule blade is always under control. Case completely encloses blade and practically excludes dirt. Blade and case are attached, hence they cannot be separated and either one mislaid.

Showing rigidity and accuracy of CRESCENT Tape-Rule when projected into space, measurement being taken with extreme end of tape butted against door frame.



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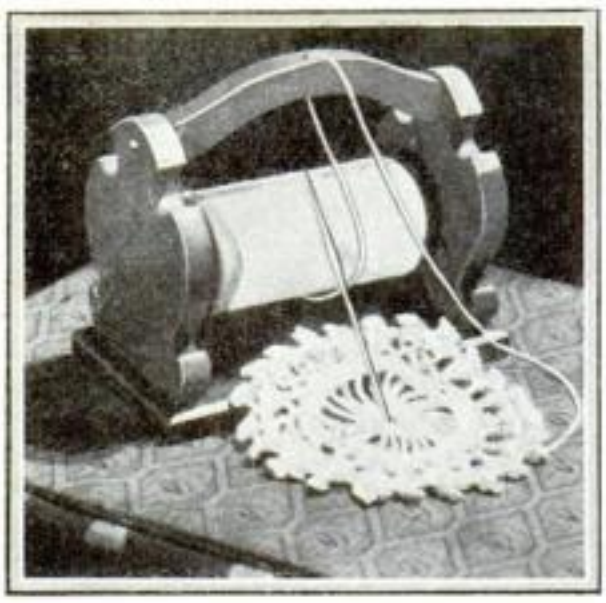
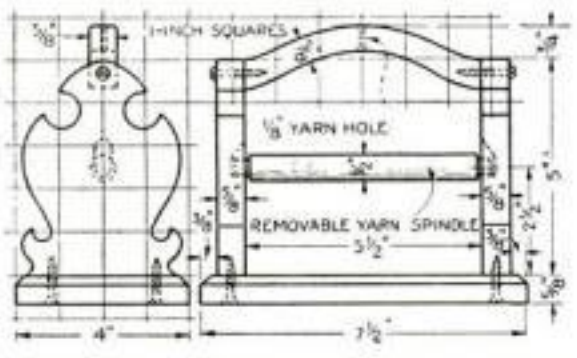


A NOVELTY HOLDER FOR CROCHETING YARN

THIS attractive little yarn holder should appeal to the handy man whose wife has to spend her evenings alone, perhaps crocheting, while he is busy in his workshop. Lay out the design of the ends and handle on cardboard, and transfer the outlines to ⅝ in. thick walnut or other hardwood. Cut out these parts with a scroll or jig saw, and in the center of the handle drill a ⅛-in. hole for a yarn guide. This hole should be countersunk on both sides as shown. The base is a rectangular piece of the same thickness, beveled on all sides; or a molded design may be substituted if a shaper or molding cutter is available. To hold the yarn beam or roll, it is necessary to turn a spindle ½ in. in diameter with ⅜-in. shoulders on each end to fit in the recesses in the two uprights. Bore the ⅜-in. holes in the end pieces only halfway through, and chisel a tapering groove in toward the center, as shown by dotted lines in the drawing. These grooves will allow the yarn roll to be slipped in and out at will. Fasten the ends to the base with countersunk screws, and the handle to the ends with oval-headed brass screws. Sandpaper all parts thoroughly, apply an oil stain, and finish with wax.—RICHARD H. SPESSARD.



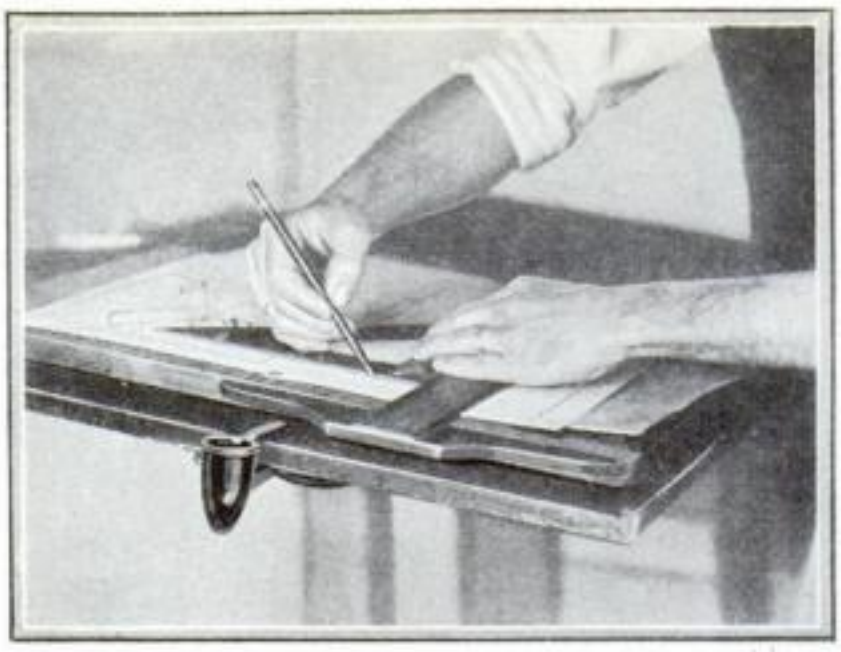
Grooves in the sidepieces make it an easy matter to replace the yarn in this holder.

WOOD BLOCK STIFFENS SMALL SIZE DRILLS

WHEN drilling a hole with a very thin drill in material which requires a good deal of pressure, run the drill first through a block of wood that is as thick as the length of the drill minus the depth of the hole to be drilled. Hold or clamp the block stationary while drilling. The drill cannot bend in the block, and much more pressure can be applied than if it were unprotected. This reduces to the minimum the danger that the small drill will break.—EMIL J. NOVAK.

THREE AIDS FOR DRAFTSMEN

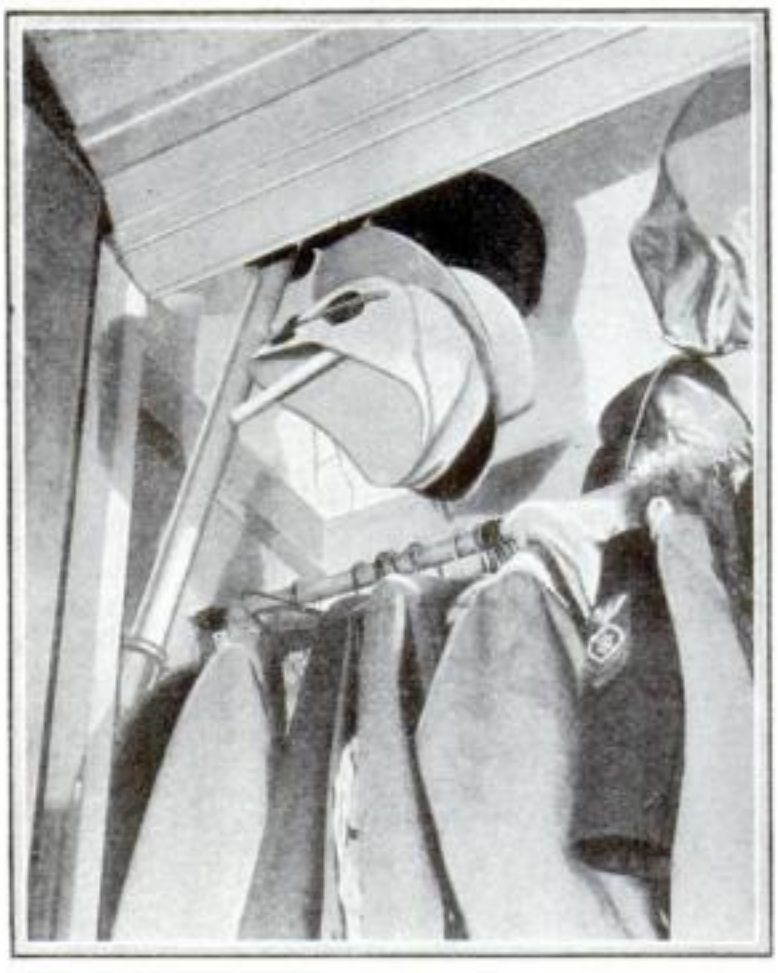
PATCHES of heavy cloth or adhesive tape fastened to both sides of drafting triangles and French curves and to the underside of the T-square are a great aid in keeping mechanical drawings from becoming smudged. The tabs slide easily, interfere very little, and greatly reduce the danger of blotting. Inexpensive automobile ash receivers, purchased at five-and-ten-cent stores, make handy containers for thumb tacks, paper clips, pins, and other small odds and ends used by a draftsman. The kind with steel clips can be attached instantly to the edge of the table, and those with suction disks may be stuck to the wall or other convenient surface. Automatic pencils are excellent for laying out, as the thin leads retain fine points for a long time. Choose the cheap ten- or fifteen-cent variety having long, slender bodies and no pocket clips. File the metal points to sharp edges so that they taper smoothly into the leads, leaving no ridges to climb the straightedges. Run the lead out 3/16 in., sharpen on sandpaper or file in the regular way, and use with a twirling stroke. This style of pencil is especially good for laying out line drawings from which printing cuts are to be made. Use blue lead instead of black; then none of the construction lines that are not inked need be erased because blue does not photograph on white paper. This is better than trying to clean up a drawing, because even the most careful use of a sponge eraser results in some weakening of the inked lines.—EDWIN M. LOVE.



VERD GREEN FINISH FOR COPPER AND BRASS

AN ATTRACTIVE verd green finish on either copper or brass can be obtained through the use of nitric acid. Place a small quantity of commercial nitric acid in a jar and carefully drop small pieces of scrap copper into it until the acid will not dissolve any more. This work should be done outdoors, as the action gives off an acrid blue smoke which is injurious if breathed in large quantities and which corrodes metals. Next, make a small swab by wrapping a piece of cloth around a stick and with this wash over the pieces to be finished with the solution. Wet the metal thoroughly but do not allow the acid to remain on the surface in large drops. When coated, hold the pieces over a Bunsen burner with a pair of pliers until the green finish appears, then remove and apply a thin coat of floor wax or polish to preserve the finish. As the finish ages, it takes on a range of antique colors, making it especially suited for lanterns and similar pieces.—DICK HUTCHINSON.

CLOSET HATRACK MADE FROM FLAGPOLE

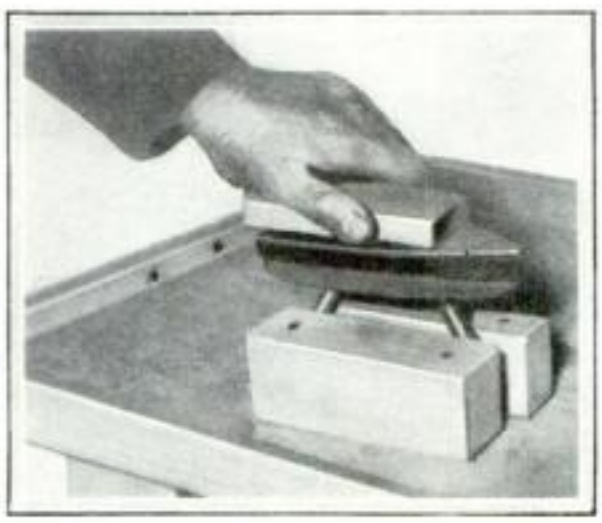


A small flagpole, cut off to a convenient length and inserted in its socket, forms a removable closet hatrack.

RARELY is there enough room in clothes closets for hats, especially when guests are being entertained. It is a simple matter, however, to make a hatrack that will carry five or six hats and still be out of the way of the clothes hangers and shelf in the average closet. Obtain an old flagpole socket and mount it about 4½ ft. from the floor at the left side of the closet door. Cut off a convenient length of the pole and bore ⅜-in. holes into it at an angle of 45°—as many holes as you wish to have hat pegs. Into these holes glue 9-in. lengths of ⅜-in. dowel sticks. The rack is used by lifting the pole from the socket to take or replace the desired hat. In this way the space of the closet can be utilized right up to the ceiling. If desired, two hatracks can be used, one being placed each side of the door. The hat pegs can be improved by the addition of a small wooden ball at their ends.—C. EDWARD PACKER.

TRUING UP THE SURFACE OF A WORN OILSTONE

WHEN worn away unevenly in the center, an oilstone can be restored to a true surface with very little work. An old flatiron (or any scrap piece of flat surface cast iron) is set up on the bench as shown. Carborundum powder is dusted on the iron and moistened with



During the reshaping process, the abrasive mixture should be replenished as necessary.

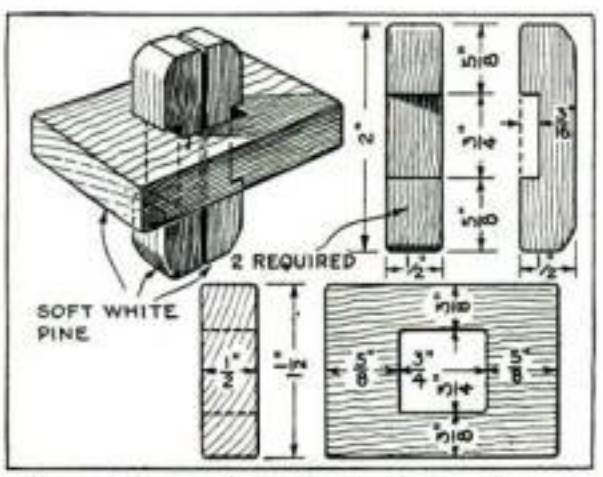
kerosene. The stone is then rubbed back and forth slowly and with considerable pressure. The abrasive mixture is renewed as necessary and the rubbing continued until the hollows disappear.

In using the reconditioned stone, try to rub your chisels, plane irons, and other tools over the entire surface in such a way as to avoid forming hollows. Keep the stone in a box so that dust will not collect on it; oil it well before using; and wipe it clean when you are through using it.—EVERETT EAMES.

SOAKING IN HOT WATER SOLVES THIS PUZZLE

IF YOU were given the wooden puzzle illustrated and asked to remove the two notched blocks from the piece with the square hole, how would you do it? You would probably find it impossible, yet the solution is really simple. The ends of the two small blocks are soaked in hot water for a few minutes until the wood is soft and pliable and can be compressed sufficiently to allow the pieces to be taken apart.

This is a companion puzzle to the cut string trick previously described (P.S.M., May '31, p. 112).—E. R. CROWDER.



A wooden puzzle that is simple to make and easy to solve—when you know the trick.

Model of Fokker's War Plane

The Famous "D-7"

By Donald W. Clark

The D-7, designed during the war to defeat a rival airplane manufacturer, was the fighting ship that made Fokker famous. All along the Western Front these planes made aerial history.

SPEED, grace, and daring are all symbolized in this simplified scale model of the famous Fokker D-7. At the close of the World War, Fokker ships were supreme in the German army, and the D-7's especially were accredited with being the most efficient scout and fighting planes in the air. Those who remember Baron von Richthofen and his "Flying Circus" will recall the aerial history written by these knights of the air in their famous Fokker fighting ships.

Like all the models in this popular series of whittled planes, the D-7 is made almost entirely from soft wood. The fuselage is whittled from a 1 by 1⅜ by 7⅜ in. blank. When the fuselage is completed, cut the two slots to take the horizontal and vertical tail units as indicated in the drawings.

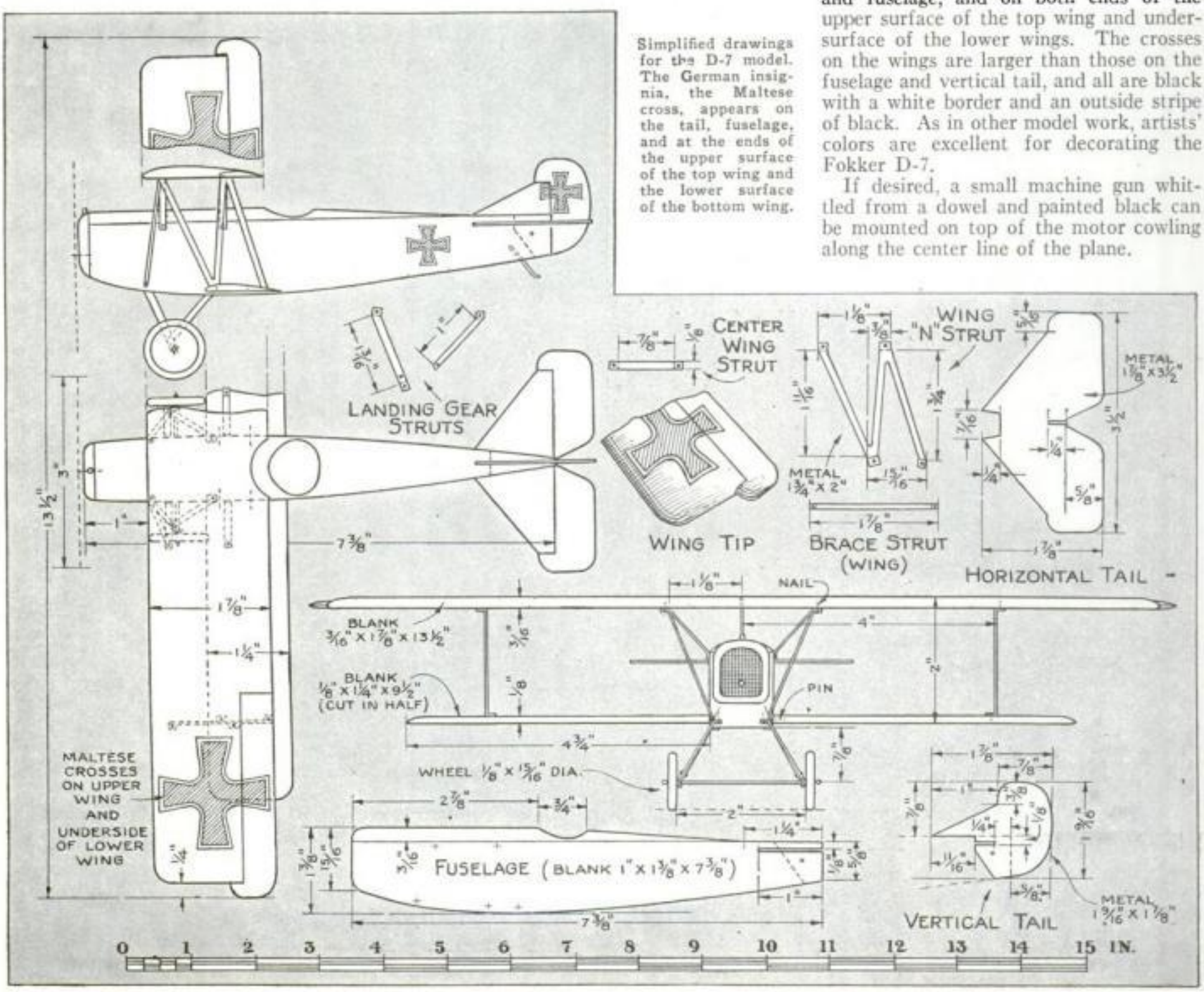
The lower wings are whittled as a single unit from a ⅛ by 1¼ by 9½ in. blank and then cut in half and attached to the fuselage with pins.

The wing strut used on the Fokker D-7 is similar to that now used on the Curtiss *Hawk* (see P.S.M., Jan. '31, p. 89). These wing struts, together with the wing braces, landing gear struts, tail units, and propeller, are cut from thin sheet metal.

While the Germans had no official color scheme for these planes, a majority of them were colored as follows: Wings, tail units, and fuselage, dark green; and struts, wheels, and propeller, orange. The German insignia, the Maltese cross, appears on both sides of the vertical tail unit and fuselage, and on both ends of the upper surface of the top wing and under-surface of the lower wings. The crosses on the wings are larger than those on the fuselage and vertical tail, and all are black with a white border and an outside stripe of black. As in other model work, artists' colors are excellent for decorating the Fokker D-7.

If desired, a small machine gun whittled from a dowel and painted black can be mounted on top of the motor cowling along the center line of the plane.

Simplified drawings for the D-7 model. The German insignia, the Maltese cross, appears on the tail, fuselage, and at the ends of the upper surface of the top wing and the lower surface of the bottom wing.



HOLDING ODD-SHAPED STRIPS IN A VISE

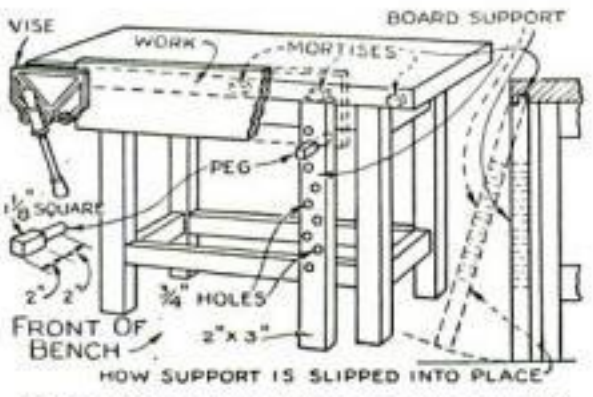
Stock can be conveniently held in this manner for shaping and boring.

WOODEN strips of awkward shape often can be held for planing, boring, shaping with a spokeshave, or sandpapering by the method illustrated above. A cabinetmaker's bar clamp is set up in the vise, and the work is gripped lengthwise in the position desired between the jaws of the clamp.—ALBERT SCOTT.

A MOVABLE SUPPORT FOR PLANING LONG BOARDS

A PLANING support for long work is a valuable addition to any woodworking bench, especially if made so that it can be set up in several different positions like the one illustrated. This attachment is useful not only to hold the rear end of long, wide boards, but also doors to which lock and hinges have to be fitted, and other work which cannot conveniently be held in the ordinary bench vise alone.

The support is nothing more than a length of 2 by 3 or 2 by 4 in. stock with a few ¾-in. holes bored as indicated on centers about 2 in. apart. A ½ in. long tenon is cut on the top, and a piece of old inner tube is tacked over the bottom to prevent slipping. To receive the tenon,



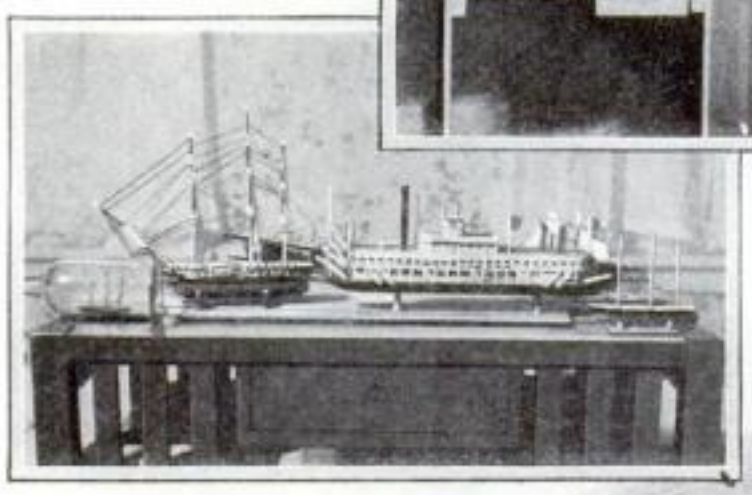
Perspective showing support in use and side view indicating how it is slipped in place.

several mortises are cut in the underside of the bench top near the front edge. These should be about 18 in. apart.

In use, the tenon is slipped into whichever mortise is most suitable for the length of the work at hand, and a peg for supporting the work is placed in one of the holes. The front end of the work is then clamped in the vise.—R. C. RANDLE.

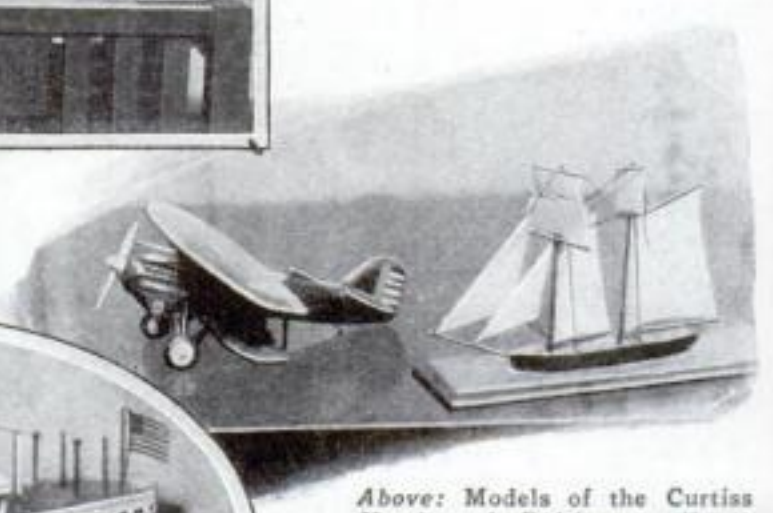
RUDY WOODS, boy of 15, Builds His Own *Machines for Model Making*

At right: Rudy Woods working with his home built machinery, which cost him $12.57 for materials. The machines include two wood lathes, jig saw, circular saw, grinder, buffer, and a drum and a disk sander.

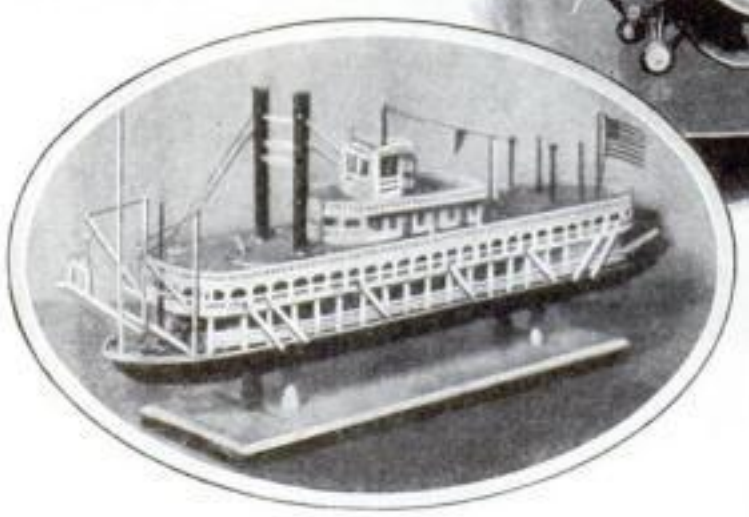


At left: Ship in a bottle and models of the *Constitution*, *Buckeye State*, and *Flying Cloud* built by Rudy.

In building the *Buckeye State*, shown below, Rudy Woods obtained additional information from one of the original crew.



Above: Models of the Curtiss *Hawk* and Baltimore clipper form part of his collection.



WHAT can be done by an ingenious and energetic boy who enjoys working with tools is graphically shown by the accompanying photographs of shop equipment and models made by Rudy Woods, 15 years old, of Portsmouth, Ohio.

Not being able to spend a great deal for tools, Rudy makes his own whenever possible. His motorized equipment cost $12.57 for materials, and here is what he has: a lathe, 9-in. swing, 33 in. long; a small lathe for deadeyes and ship model parts; a jig saw run by a sewing machine head (cost 67 cents); a small circular saw; and a grinder, buffer, drum sander, and disk sander.

Iron angles from an old bed were used in making the large lathe. A lever type tailstock was constructed of three pieces of 2-in. maple, bolted together. A cast-iron pulley, flat on both sides, was converted into a faceplate by drilling and countersinking four screw holes. The live center was made principally from a piece of heavy ½-in. pipe and a bolt.

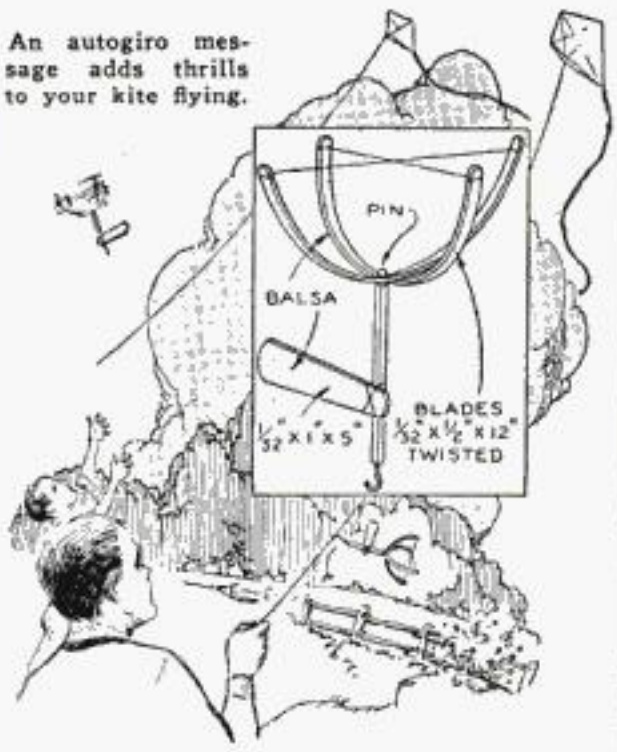
Among the models Rudy has made, most of them from POPULAR SCIENCE MONTHLY plans, are: *Constitution*, *Buckeye State*, ship model in a bottle, Curtiss Army *Hawk*, *Flying Cloud*, small Baltimore clipper, and *Tom Greene* (a famous Ohio River packet).

In the case of the *Tom Greene*, Rudy obtained the necessary plans from Captain Tom Greene himself. Writing of his model of the *Buckeye State*, which he built from our Blueprints Nos. 94, 95, and 96 (see page 99), Rudy made this interesting comment:

"As a matter of curiosity, I counted the pieces and found that the model contained 536 pieces, the paddle wheel having 108."

In a hobby contest conducted last year by the Y. M. C. A. in Portsmouth, Rudy was awarded first prize for his models.

AUTOGIRO MODEL DROPS FROM KITE STRING

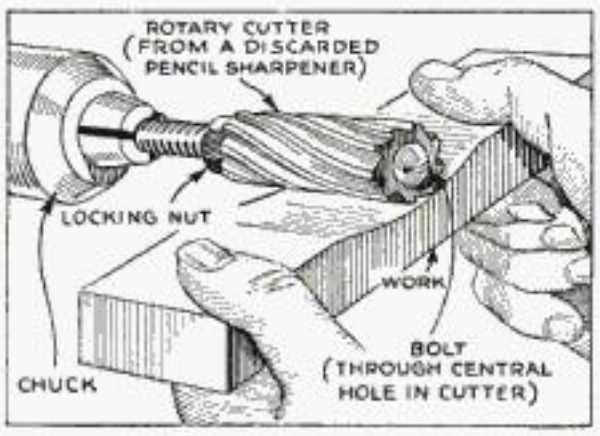


A SIMPLE little autogiro for your kite string can be made from thin balsa and a stick. Make the four revolving blades as shown and fasten them to the stick with a glass-headed pin so they will turn freely in the wind. The blades should be very slightly twisted, all in the same direction. A thin balsa fin prevents the stick from turning.

Make the hook from a wire paper clip, bent so that it can be dislodged easily when the kite string is jerked. The autogiro will slide all the way up the kite like a paper "message," and then float down slowly and gracefully when it is jerked loose. A number of boys can compete to see whose autogiro takes the longest time to reach the ground.—HI SIBLEY, JR.

OLD PENCIL SHARPENER YIELDS GOOD CUTTERS

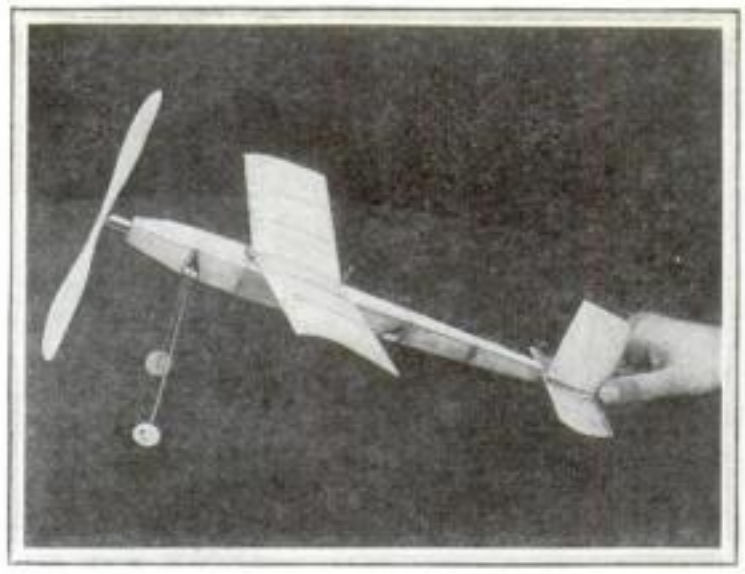
ROTARY knives from a discarded pencil sharpener make good milling cutters for surfacing soft metal castings or for edging irregular pieces of wood before finishing them with sandpaper. The knife is placed on a small bolt, which passes through its center, and is held firmly by



Besides shaping soft metal, these cutters make excellent routers for wood shapers.

a nut. The end of the bolt is then placed in a chuck on the lathe shaft or on the end of a motor-driven flexible shaft. This cutter may also be used as a router on an ordinary wood shaper if desired.—LESTER P. YOUNG.

By EDWIN T. HAMILTON



Landing gear and fuselage change the hand launched single stick combination into a fuselage rise-off-ground model.

How to build a FUSELAGE *for your* 20-*in*-1 Model

BY BUILDING the fuselage shown in the accompanying illustrations, you can convert the unique new POPULAR SCIENCE MONTHLY twenty-in-one airplane model into any one of ten different types of fuselage models.

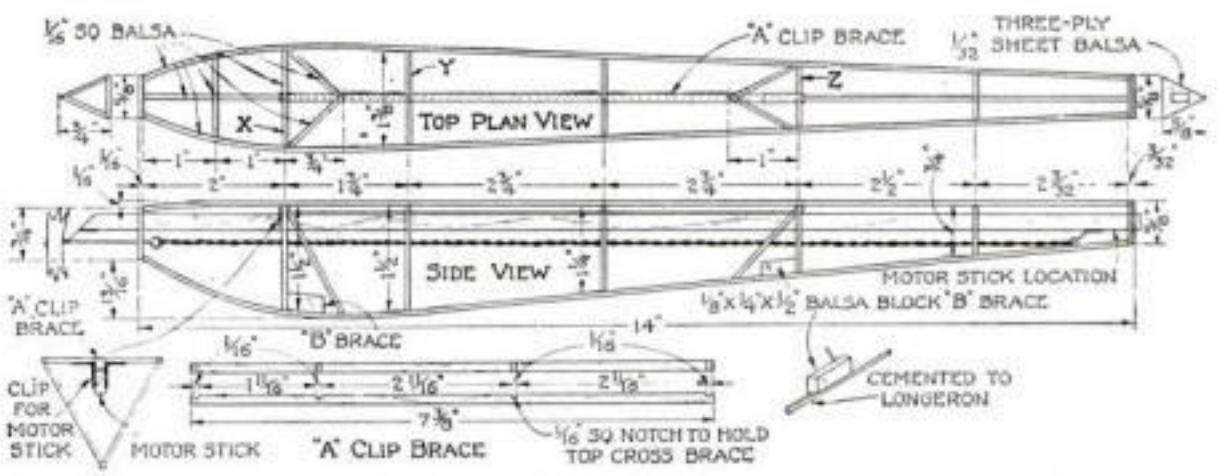
How to make the parts for assembling ten single-stick models was told last month (P.S.M., Aug. 31, p. 72), but those who missed that issue can easily build them from POPULAR SCIENCE MONTHLY Blueprints Nos. 135 and 136 (see page 99), which contain complete, full size drawings of the parts for all twenty models, ten of the single-stick type and ten of the fuselage type.

In this article only the fuselage models will be described, inasmuch as the motor stick, propeller, elevator, rudder, motor, wing, and landing gears are the same as for the ten combinations of single-stick models.

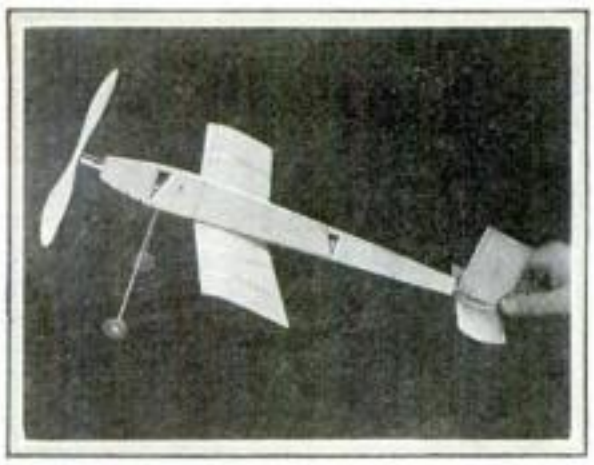
The fuselage is of the "commercial" or triangular design. The three longerons and all cross braces are of 1/16 in. sq. balsa wood. The tail brace is of three-ply balsa (three pieces of 1/32-in. sheet balsa cemented together) with a 1/16 by 1/8 in. hole cut in it to accommodate the motor stick.

Lay out the top view of the fuselage. Cement the two longerons to the tail brace. Cut two 1/16 in. sq. cross braces 1 3/8 in. long and cement them between the longerons at the positions marked *X* and *Y*. Cut the front cross brace 5/8 in. long and cement it between the longerons 2 in. in front of brace *X*. Cut to length and cement in place the remaining cross braces.

The 1/8 by 1/8 by 7 3/8 in. clip brace marked *A* is now cut and notched to allow the cross braces to fit into it. This is cemented from the underside of the



Drawings detailing the construction of the fuselage, which is of the "commercial" or triangular type. The fuselage is covered with Japanese tissue and coated with dilute dope solution.

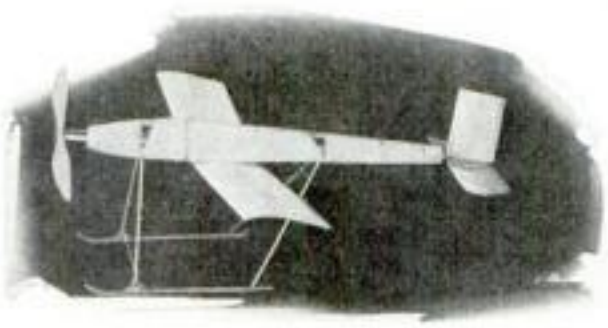


In the rise-off-ground, low-wing model, the landing gear is attached to the front brace.

cross braces. It extends 1/32 in. beyond braces *X* and *Z* as shown.

A large clip is shaped from No. 6 piano wire with a ⅛ by ¼ in. opening; this is cemented to the underside of cross brace *X*, as shown, to hold the front end of the motor stick in place.

The third 1/16 in. sq. longeron is now cemented to the tail brace. Four 1/16 in. sq. side braces are cut 1½ in. long and cemented to the underside of the two top longerons at the points of top braces *X* and *Y*. Their other ends are cemented together, completing two triangles. The

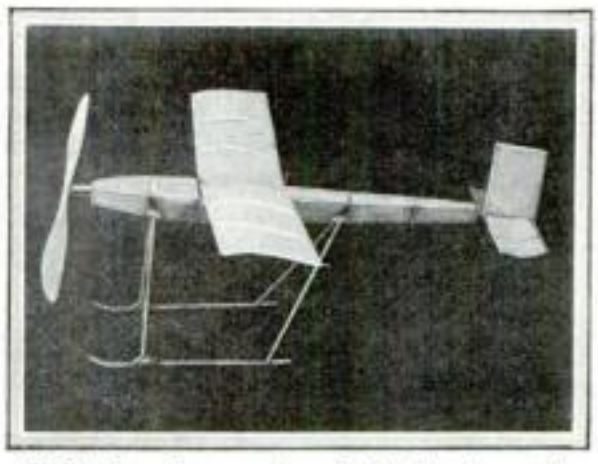


By changing to ski landing gear, the model can be converted into a rise-off-snow plane.

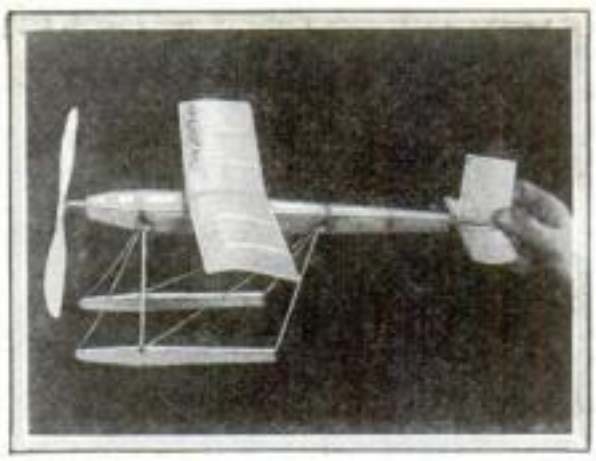
lower longeron is now cemented to them. The two side braces of the nose triangle are cut ¾ in. long and cemented together. The front end of the bottom longeron is cemented to them.

The remaining side braces are cut and cemented as shown. Two blocks *B*, ⅛ by ¼ by ½ in., are cut from balsa wood and cemented to the top of the bottom longeron. Four braces, extending from braces *X* and *Z* to the bottom longeron, are cemented in place.

Japanese tissue is used to cover the fuselage. The top is not covered between the *X* and *Z* braces. Both sides are covered with exception of the triangles formed by the side braces on each side of the *B* brace blocks. These are left open to allow the clips of the landing gears to



With the wing on top of the fuselage, the model is the high-wing, rise-off-snow type.



Pontoons attached to the front brace convert the model into a rise-off-water combination.

fit over the *B* blocks. One coat of diluted dope is given the fuselage.

These ten fuselage models consist of five low-wing or "underslung" types and five high-wing models. The low-wing models have made splendid records in speed, and the normal high-wing types give the best endurance performance, as a rule. The assembly for each follows:

High-Wing (Hand Launched). Attach motor stick. Fasten elevator to rudderpost by its clips. Insert rudderpost into hole in motor stick. Attach the wing to the *A* clip brace by the wing clips on its concave side. Glide the model before attempting motored flight and adjust the wing until a long, smooth glide results. Wind the propeller about 200 times and test. If smooth, level flight results, the motor may be wound to capacity and the model released. Weight of original model, 7 drams; average flight, 1 min. 45 sec.

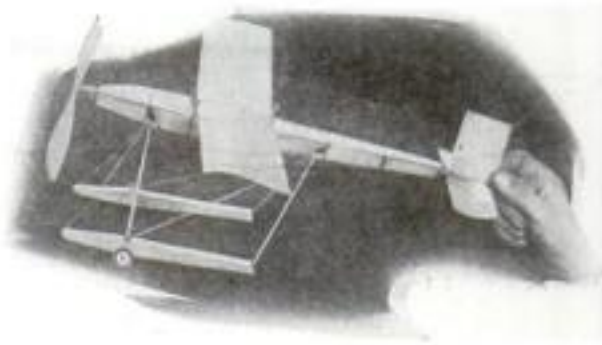
High-Wing (R.O.G.). Same general assembly. Attach wheel landing gear to the front *B* brace. Weight, 8 drams; average flight, 1 min. 19 sec.

High-Wing (R.O.W.). Attach pontoons without wheels to *B* braces. Weight, 10 drams; average flight, 55 sec.

High-Wing (Amphibian). Attach pontoons with wheels. Weight, 10.5 drams.

High-Wing (R. O. S.). Attach ski landing gear to *B* braces. Weight, 10 drams; average flight, 1 min.

Low-Wing (Hand Launched). Attach motor stick in the same position, but turn fuselage over so that the single bottom longeron rides on top. The rudder and elevator are attached in the same way, but the rudderpost is thrust into the hole



The addition of wheels changes a high-wing, rise-off-water combination to an amphibian.

of the motor stick upside down so that the rudder points above the single bottom longeron. The wing is attached to the *A* clip brace by its wing clips on its convex side. Its leading edge is still leading. Follow flight instructions as given for high-wing model.

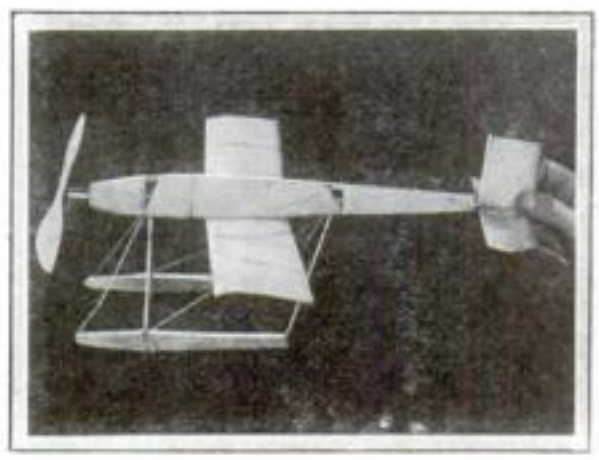
Low-Wing (R.O.G.). Attach clip of wire R.O.G. landing gear to *A* clip brace just behind *X* cross brace.

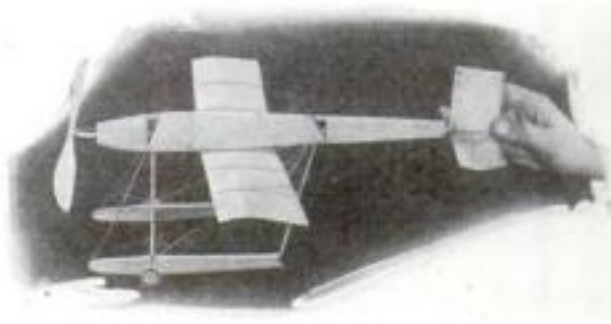
Low-Wing (R.O.W). Attach pontoon landing gear without wheels to *A* clip brace at points under *B* braces.

Low-Wing (Amphibian). Attach pontoon landing gear with wheels to *A* brace.

Low-Wing (R.O.S.). Attach ski landing gear to *A* clip brace.

This completes the twenty-in-one model. Bear in mind that by more difficult methods of construction, better results may be obtained, but the novice should first complete the model as described in these articles before attempting improvements.





The low-wing, rise-off-water model, shown at the left, and the low-wing amphibian, shown above, complete the list of combinations.

CLEANING CLOCKS THE JEWELER'S WAY

AFTER spring-wound mantel and alarm clocks have been in service for some time, they often stop because they are clogged with dirt. This may be remedied by using a gasoline bath.

Remove the works from the case. If it is an alarm clock, be sure to take off the face; and if it is a mantel clock, remove the pendulum. Wind the spring until reasonably tight and place the works in a bath of gasoline. After they have soaked for a time, clean all the pivot holes with a small brush such as a new paste brush or an old toothbrush with all but about ¼ in. of the bristles cut off one end. Brush carefully around the escapement, taking care not to disturb the hairspring. When the mainspring is unwound, brush between the layers. Wind the spring again and allow the works to run in gasoline.

Oil the works when dry. Use a good grade of typewriter oil and apply it sparingly to all pivot holes, gears, escapement, and springs with a small toothpick or hairpin flattened at the end. If the clock will run only when on its face, carefully tighten the bearing nut or screw on the escapement.—L. N. YEPSEN.

Lifelike Figures Win PRIZES in Match Stick Contest

Milton Clifford was awarded first prize for the figure in his entry, *The Prisoner.*

MANY realistic models whittled from ordinary kitchen match sticks were submitted in our recent match stick model contest (see P.S.M., May '31, p. 85). Some of the models were human figures, some were intricately carved chains, and others were diminutive pliers and similar examples of trick carving.

First prize was awarded to Milton Clifford for the figure in his model, which he called *The Prisoner*. According to the rules, as given in the announcement of this contest, the entries were judged on the basis of the best figure or model whittled from a single match stick and not upon the entire group in each instance where a contestant submitted two or more figures. In the case of *The Prisoner*, it was the independent figure of the prisoner that won the prize for Mr. Clifford.

Theodore Jefferies won second prize with his *Boxing Bout*. In this case the best figure of the three was used by the judges in determining the relative value of the entry.

Third prize went to thirteen-year-old Jack Cunningham for the lifelike model of a horse in a group showing a horse and rider crossing the desert.

The remaining prize winners submitted models of acrobats, chains, pliers, deer, baseball players, ship models, airplane models, and numerous other interesting examples of what one skillful with a penknife can whittle from a match stick.

The complete list of prize winners is as follows:

First Prize, $25

Milton Clifford, Springfield, Mass.

Second Prize, $15

Theodore Jefferies, Newark, Ohio.

Third Prize, $10

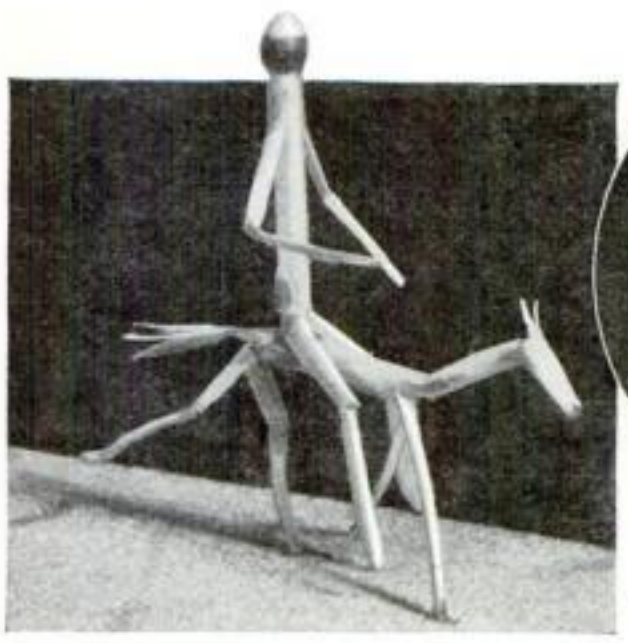
Jack Cunningham, Waco, Texas.

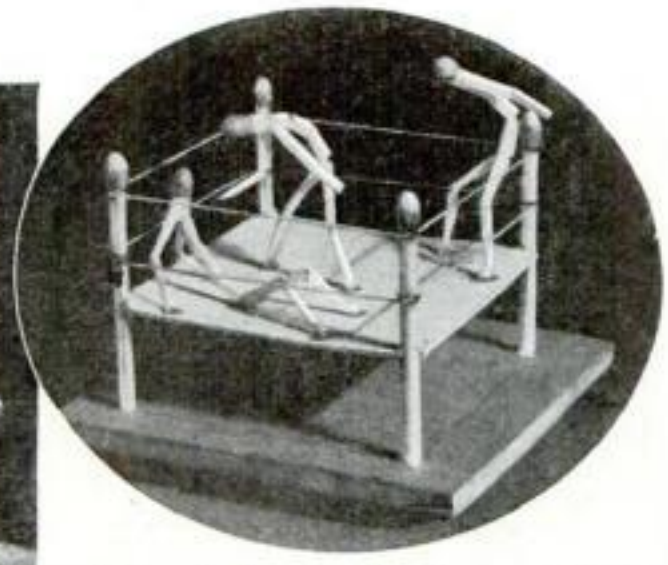
Three Prizes of $5

Ira B. Thaxton, Tracy, Minn.
John C. Rowe, Fresno, Calif.
Ida Peterson, Brooklyn, New York.

Ten Prizes of $2

Hattie Little, Sebastopol, Calif.; Robert Oakley, Memphis, Tenn.; Dick Riggs, Little Rock, Ark.; Freeman Drew, Des Moines, Iowa; Lawrence Coppage, Richmond, Va.; Mrs. J. M. Formwalt, Mound, Minn.; Roger Foley, Youngstown, Ohio; Christine Layton, Santa Monica, Calif.; Melvin E. Layton, Santa Monica, Calif.; and D. R. Chalmers, Virginia, Minn.

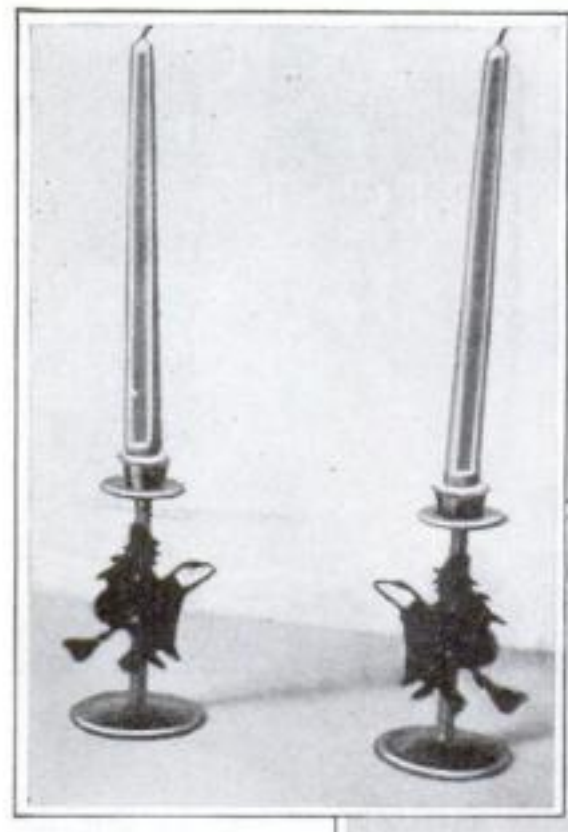




Above: Boxing Bout by Theodore Jefferies. *Left:* A realistic horse won the third prize.

Quaint Iron Candlesticks

By J. W. BOLLINGER



Made entirely of iron, these "bewitching" candlesticks are especially suited for the mantelpiece over the fireplace.

THESE novel iron candlesticks are really "bewitching." Put them on a mantel in a dark room, light the candles, and you'll see.

They are easy to make, too; for all you will need is a hack saw, a 3/16- and 7/32-in. metal drill, a No. 12-24 tap, and a tap wrench.

For the upright supports, cut two pieces of ½ in. diameter iron rod 6 in. long; then drill the ends and tap them with the No. 12-24 tap.

The bases are made 4 in. in diameter, and the "saucers" under the candles 2½ in. Almost any kind of heavy sheet iron will serve. To make the bulge in these disks, lay each of them over a short piece of large diameter pipe and strike the sheets with a machinist's hammer. Begin at the outside edge and work around toward the center until the desired shape has been obtained.

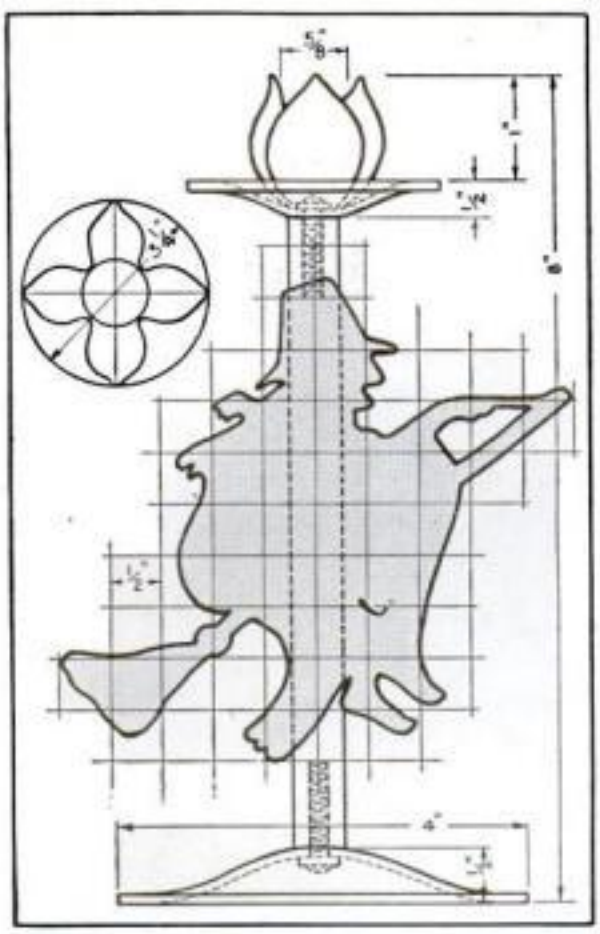
To make the cups, cut some light sheet iron according to the pattern shown. It may be best to fold a piece of paper and cut a template first. Bend the metal into shape over a piece of 5/8 in. round iron.

Raising or *dishing* the heavy sheet iron bases over the end of a piece of large diameter pipe.

Drill 7/32-in. holes through the cups, the saucers, and the bases, and assemble the candlesticks with No. 12-24 machine screws about ½ in. long. Test the assembled parts with a steel square to make sure that the candlesticks stand straight.

Rivet each of the "witches" to the candlesticks with two countersunk 3/16-in. rivets. Then apply two coats of flat black paint or black brushing lacquer to the completed candlesticks.

When you buy the candles take the candlesticks along and try several kinds to see which look best.



Assembled view of the candlestick and a pattern for making the tulip-shaped candle cup.

TELEPHOTO PICTURES

CLEAR telephoto pictures can be taken by attaching a field glass to a camera by means of a strip of fairly soft leather slightly longer than the width of the camera and a small spiral screen door spring shortened so that when it is placed around the camera and the ends are hooked into holes in the ends of the leather strip, the latter will be held firmly in place. Cut a hole in the center of the leather to receive the eyepiece of the field glass. Remove the eyepiece, insert it through the hole, replace it in the glass, and focus the glass on the object. Then, leaving the camera lens in, attach the field glass to the camera. With a box camera no other focusing is necessary, but a focusing camera must be focused on ground glass.—H. K. MURPHY.

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....
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Price 25 cents each except where otherwise noted

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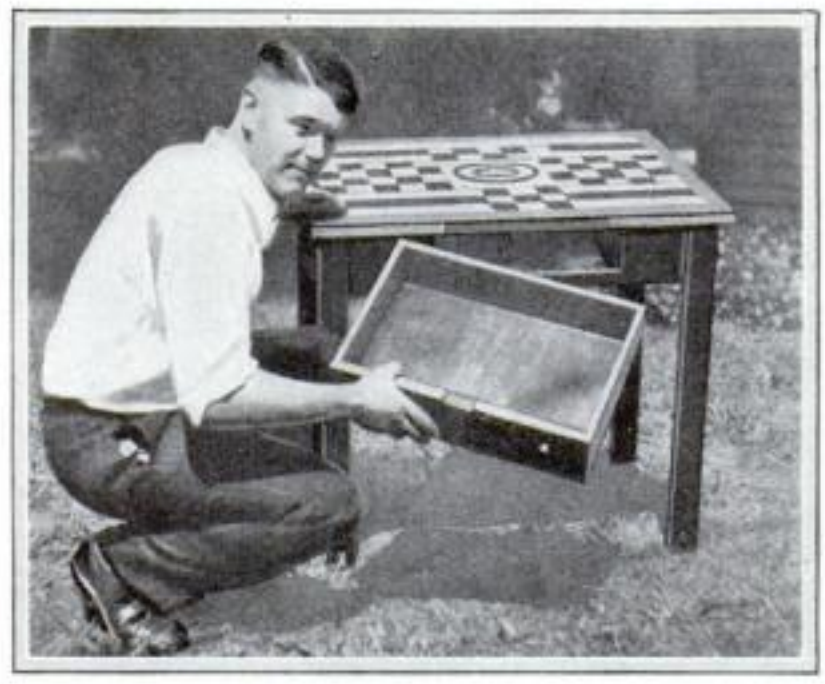
Overlays Ornament *this* Table

By WENDELL M. CALDWELL



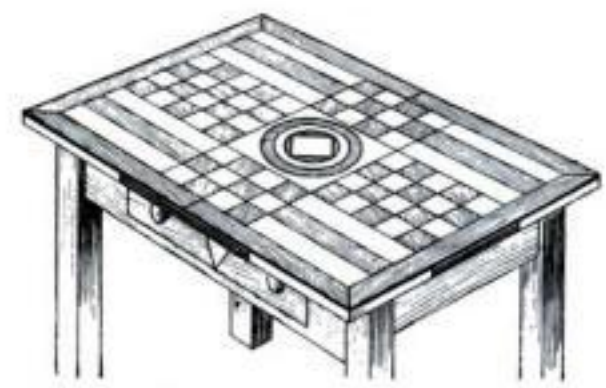
ALTHOUGH designed as a typewriter desk, the table illustrated could be used for playing bridge or other purposes. It is easily constructed because almost every cut is square. I did all the cutting on a very small, inexpensive circular saw. If no lathe is available, the central design of the top and the drawer knobs may be turned on the buffer end of a polishing spindle.

The top is an old drawing board ¾ by 23 by 31 in., upon which is overlaid ¼ in. thick maple and walnut in the pattern illustrated. The edges are also overlaid, making the finished size 23½ by 31½ in. The legs, which are 2 by 2 by 28 in., and the rails and drawer front are walnut.

The accompanying drawings show all the details with the exception of two strips ¼ by ¼ by 14 in. that are nailed under the top of the table to guide the drawer.

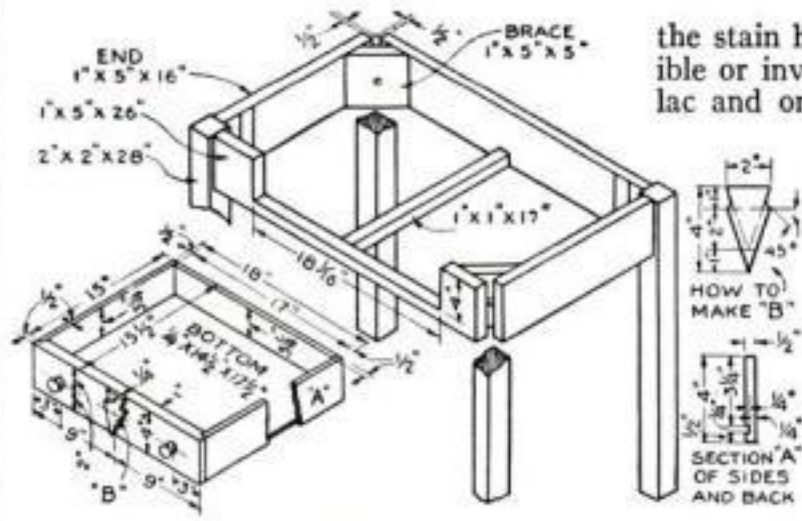
The rails and underframe are fastened to the top with 2-in. screws before the overlay is applied. The legs are held by 4-in. hanger bolts; these are like lag screws but are threaded at the head end to take an ordinary nut. This method of construction facilitates the removal of the legs for shipment or storage.

In finishing the table, the maple surfaces are first coated with white shellac so that they will remain white when the walnut parts are stained with a brown water stain. When



The top of this unusual table is a drawing board overlaid with ¼-in. maple and walnut.

the stain has dried, all parts, whether visible or invisible, are given a coat of shellac and one of waterproof varnish. The exposed surfaces require a second coat of varnish, which is allowed to dry for several days and then rubbed with rubbing felt and crude oil and pumice stone. The table is then rubbed with crude oil and rottenstone, and polished with furniture wax.

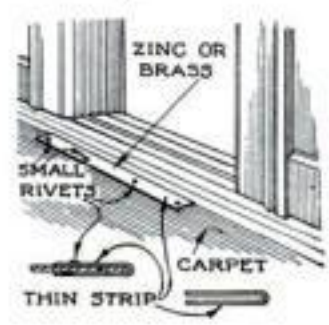


The legs, rails, and drawer front are solid walnut, except the ornament overlaid on the drawer front, which is maple.

A LITTLE dry whiting or hydrated or slaked lime added to plaster of Paris will slow down its setting.

PROTECTING EDGES OF LINOLEUM RUGS

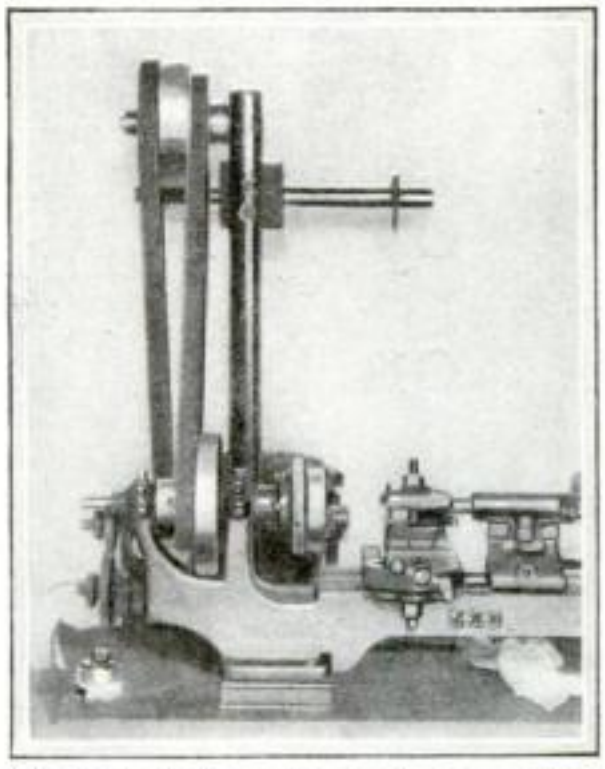
A SIMPLE and effective way to protect the edges of linoleum mats and rugs from becoming cracked and torn is to reënforce the margin wherever necessary with a strip of zinc, thin brass, or copper in the manner illustrated at the right. The length of the strip will depend on the amount of the edge which is likely to be damaged. If you wish to protect the rug in front of a door or window, 2 or 3 ft. will suffice, and it is just such places that are the first to show serious signs of wear. The metal, which is bent U-shape and flattened with a hammer after it is put in place, can be fastened with small rivets set not less than ½ in. from the edge of the rug. The strip may be cemented in place.—H. L. WHEELER.



A definite program for getting ahead financially will be found on page four of this issue.

SIMPLE WAY TO DRIVE A SMALL LATHE

WHEN installing a small home workshop lathe it is sometimes difficult to set up the countershaft and motor without ruining the walls or ceiling. The accompanying illustrations show how this was overcome in one case by mounting the ¼-H.P. motor directly on the bench with the lathe. It is surprising what an efficient drive this makes; besides, the

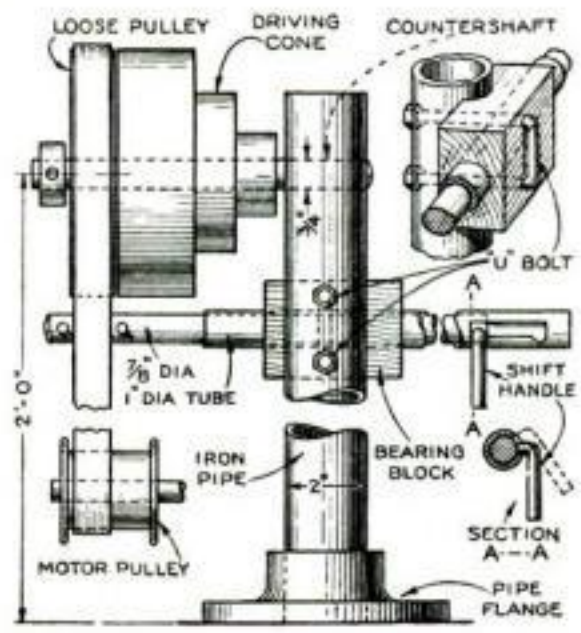


The lathe bench can be moved as a complete unit when equipped with this countershaft.

workbench becomes a unit that can be moved around.

The upright is a 2 in. outside diameter iron pipe screwed into a suitable pipe flange. The driving cone from the regular countershaft may be used, but the writer, who has a machine shop, made one as shown—three steps with the third and widest step serving also as the tight pulley. The loose pulley also can be taken from the countershaft.

The belt shift is made by mounting a piece of pipe or tube on a wooden block shaped to fit both the upright and the shifter tube and secured by means of a U-bolt. The driving pulley on the motor is about 2 in. wide and is of the flanged type.—GEORGE BENDER.



Sketch showing how this simple lathe drive is assembled. Pipe serves as the upright.

Toy Health Horse Gallops on Old Bumper Spring

By CARL O. LANDRUM

TO SATISFY a small child's natural craving for action, few toys are better adapted than the easily made and inexpensive spring health horse illustrated.

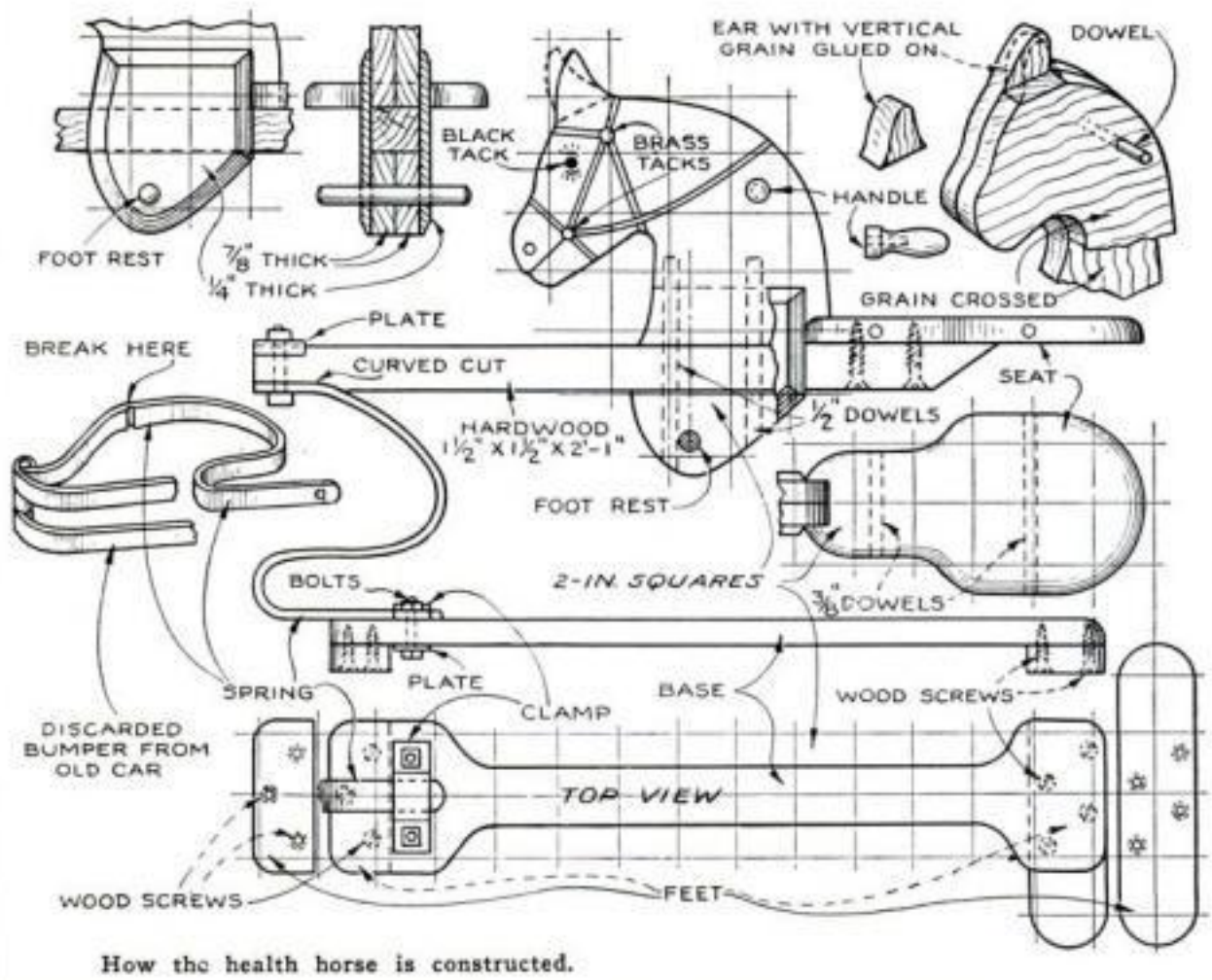
The spring is from an automobile bumper of the type illustrated in the drawings, obtained in a "graveyard" of old cars. A groove is ground completely around it at the point indicated, so that it can be broken. The end of the S-shaped piece is then dressed on the emery wheel.

For the base ⅞-in. hardwood is used, but the feet can be of softwood. Countersink the screws.

The spring is attached to the base with a clamp taken from the same bumper. Two 11/32-in. holes are drilled in the clamp, and a piece of ¾ by 4 in. strap iron is similarly drilled and then tapped so that it can be used under the base to give a good anchorage for the 5/16-in. machine screws which hold down the spring.

Head and neck are cut from a two-ply block of softwood, each piece ⅞ in. thick, the grain of one crossing that of the other. The easiest way to give the head the appearance of having two ears is to form one of them from an additional block as shown, with the grain running the long way of the ear; then both ears will have the grain running the right way to insure strength.

The arm which supports head and seat



How the health horse is constructed.

is a piece of 1½ in. square pine. The head and neck are clamped to it in the proper position, and two ½-in. holes are bored from the bottom through the lower neck piece and the arm and into the upper piece for an over-all depth of about 7 in. Remove the chips, apply a good glue to the joints, and again clamp the pieces; then drive ½-in. dowels into the holes.

The seat is made of softwood reënforced with two ⅜-in. dowels, which are inserted crosswise as shown. Hold the stock in a vise or clamp while driving the dowels to guard against splitting. Dowels should fit snugly but not too tight.

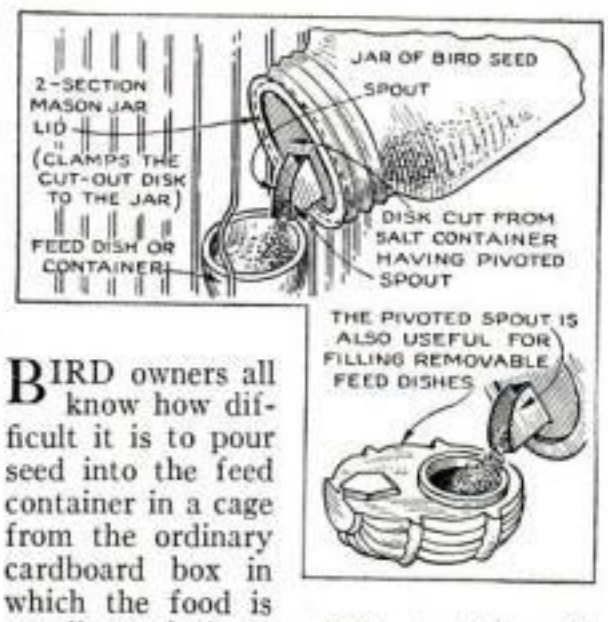
To add strength to the head assembly and give a rounder appearance to the neck, two splice plates of ¼-in. softwood are cut as shown and glued and clamped in place. Afterwards their edges are beveled with a chisel, and all the other edges of head, neck, and top of seat are rounded with a rasp, coarse file, and sandpaper.

IN BORING the holes for foot rest and handle, keep them perpendicular to the surface of the neck; even a slight angle would be noticeable in the finished toy. Let the foot rest project 3 in. on each side, and drive a finishing nail up from the bottom of the neck to lock it in place. The handles are turned as shown and are glued and doweled strongly to the neck. If a lathe is not available, the handles may be made like the foot rest.

By the use of the clamp made as indicated of ⅛ by 1 in. strap iron, it is possible to fasten the wooden arm to the upper end of the spring with a single ½ by 3 in. bolt. Cut the arm on a slight curve to suit the spring; this will help to prevent the arm from turning.

On the horse illustrated the colors used were: head and neck, white; seat, arm, and handles, red; and base, spring, foot rest, striping for bridle, and mane, black. Brass upholstery nails are used on the bridle and black ones for the eyes.

SPOUT AIDS IN FILLING BIRD SEED GLASSES



BIRD owners all know how difficult it is to pour seed into the feed container in a cage from the ordinary cardboard box in which the food is usually packed. A solution to this problem was suggested by the pivoted spout on a salt container. I cut out the top of the salt box and placed it inside the metal rim of an old style two-section mason jar lid, as illustrated. This provided the jar with a spout from which the bird seed could be poured.—NORMAN BILDERBACK.

A definite program for getting ahead financially will be found on page four of this issue.

 Ⓢ This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS... See page 6

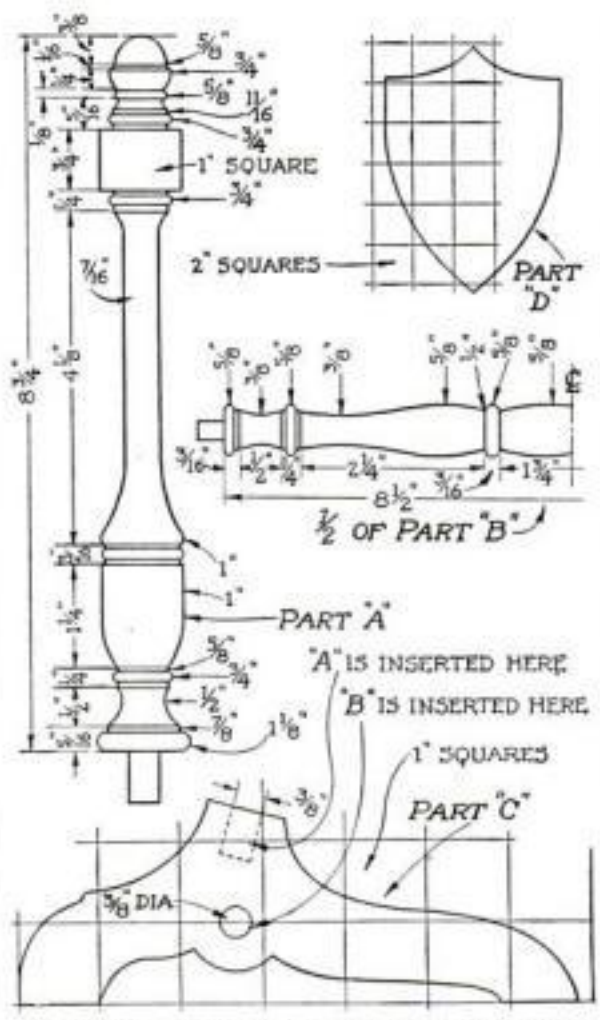
UNIQUE TILTING MIRROR FOR USE ON DRESSER OR CHIFFONIER

A vanity mirror that can be tilted at various angles.

THIS unique and decorative little vanity mirror can be constructed by anyone who owns a wood turning lathe. It is intended to be placed on a dresser or chiffonier. The glass is screwed to a slightly larger wooden backing piece, which is fastened to the turned uprights in such a way that it may be adjusted to any desired angle.

While I used mahogany for this piece, walnut or any other fine cabinet hardwood may be selected. The materials required are: 2 pcs. 1¼ by 1¼ by 10 in. for spindles *A;* 1 pc. ¾ by ¾ by 10 in. for stretcher *B;* 2 pcs. ¾ by 2½ by 7 in. for feet *C;* 1 pc. ¾ by 8½ by 12 in. for backing *D;* and a suitable mirror cut to shape, beveled, and drilled.

Turn the two spindles *A* and the stretcher *B,* and sandpaper them thor-



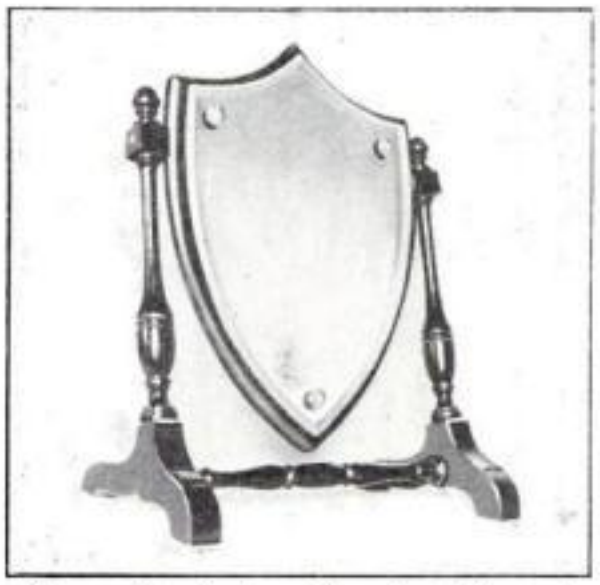
Mahogany or any fine cabinet wood may be used in constructing these graceful parts.

A definite program for getting ahead financially will be found on page four of this issue.

oughly. Cut out the feet *C* and bore the necessary holes in each. Take especial care with the holes for the spindles, which must slant back at exactly the same angle yet appear vertical when viewed from the front. After sandpapering the feet, glue the five parts of the supporting frame together.

It will be necessary to have the mirror cut and beveled at a glass works; and three 1/8-in. holes should be drilled through the glass as indicated in the accompanying photograph. Make a paper pattern for cutting the glass about 3/8 in. smaller all around than the wood backing. The particular shape shown was obtained for $2.50, but some simpler outline could have been obtained for less.

Saw out the backing and round or bevel the edges. Then fasten the glass to the



The completed mirror. The glass is fastened to the backing with three small screws.

wood with three small screws and three ornamental washers, which can be purchased with the mirror.

The mounted mirror is suspended between the two upright spindles with 1/8 by 1½ in. wood screws, tightened sufficiently to hold the glass at any angle at which it is set.

Before starting the finishing, carefully remove the mirror from the backing. Stain the wood the desired color and after twelve hours apply a good paste filler, following the directions on the can. Next apply a coat of varnish, and be sure to work in a dust-free room. Allow the varnish to dry three or four days and rub it lightly with very fine steel wool or pumice stone and water. Flow on a second coat of varnish and let it dry at least four days (this is most important); then rub it smooth as before. Replace the glass, and you will have a well-finished and attractive novelty.—RICHARD L. GRAVES.

GROUNDING YOUR MOTOR ELIMINATES SHOCKS

BY RUNNING an insulated wire from the frame of your home workshop motor to the nearest water pipe or section of electric conduit, you can effectively ground it and thus avoid the possibility of receiving a shock in case a short circuit should occur. The wire can be attached to the motor frame by placing it under one of the hold-down bolts and tightening the bolt; a ground clamp can be used in attaching the wire to the pipe or conduit.

No code need be memorized to operate this string telegraph.

Any Boy Can Operate This Novel String Telegraph

By ROBERT T. TAYLOR

A NOVEL string telegraph capable of furnishing much amusement to children, yet efficient enough for practical use, can be easily made of odds and ends. I first built the apparatus described below for two boys of the neighborhood who were convalescing in adjacent houses, their bedrooms facing across a small yard, and have since applied it for use in a dairy, a foundry, and a farmhouse. In the foundry the transmitting cord was almost 300 ft. long.

The principle of the device is elementary, its operation depending on the fact that a cord suspended between two pulleys and weighted at each end, as shown in Fig. 1, will move at one end in exact relation to a movement applied at the other end if there is no undue stretching of the transmitting cord itself.

Two identical instruments are necessary. I shall describe the simplest type, such as was built for the boys, and then suggest the improvements which followed on the later models. On a base *A*, as shown in Fig. 2, two uprights *B* were placed 30 in. apart and then braced by four arms *C*, nailed against blocks *D*. At each outer end of the braces ordinary spools *E* were placed to serve as pulleys.

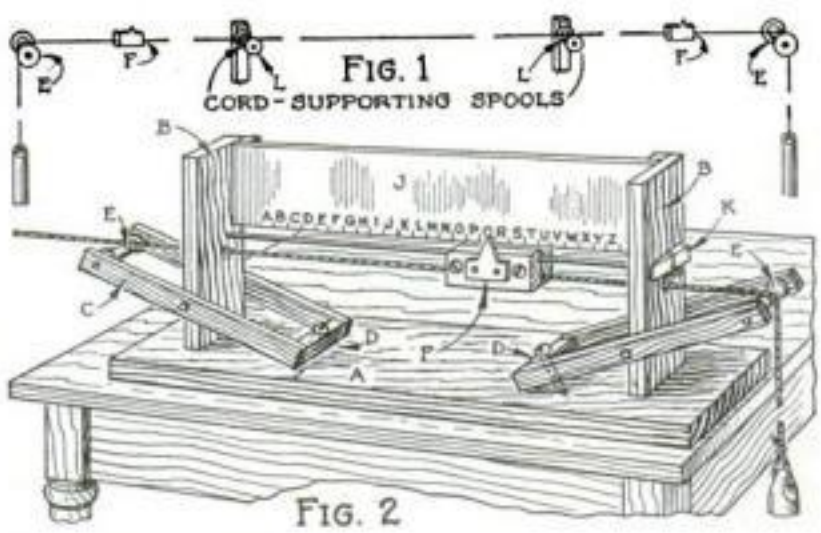


FIG. 1

FIG. 2

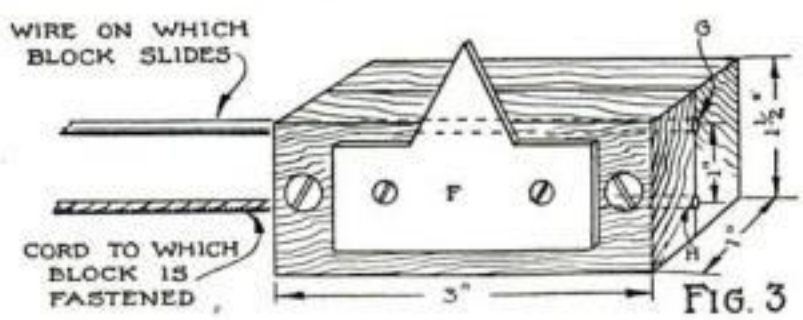


FIG. 3

How the instruments are connected (Fig. 1), perspective of one instrument (Fig. 2), and detail of indicator (Fig. 3).

On a line connecting the tops of these spools a hole was drilled through each upright to allow free play for the transmitting cord, and exactly 1 in. above these holes another set was drilled to handle a conveyor wire.

From this conveyor, which is merely a wire stretched between the two upper holes and tightened at each end by wedges as shown at *K*, an indicator block is suspended so that it may be moved back and forth by the transmitting cord.

This block and the transmitting cord itself are the only parts of the apparatus on which much care must be spent. The block, which is shown in Fig. 3 with its principal dimensions, con-

sists of two halves fastened together at the middle by screws. One of the halves carries the index pointer *F*, which can be made from thin plywood or even tin.

The halves fit together over the conveyor wire and against the transmitting cord by means of holes 1 in. apart as shown. These holes can be scribed on the facing sides of each half, the upper mark being sufficiently deep to provide a loose fit for the conveyor wire, and the lower so shallow that it will act as a clamp over the transmitting cord.

THE transmitting cord is a thick fishline (a drop line is the best type) which has been soaked in water overnight and then stretched full length in the sun to dry. Then it must be soaked in a basin of melted candle wax and again stretched overnight after the surplus wax has been removed with a cloth. This treatment produces a practically weather- and stretch-proof cord.

The alphabetical index is left until each of the two instruments is almost completed. Since this index must tally exactly on each instrument, I find it better to make two at a time, using one as a pattern so that the other will be identical.

The index is shown at *J* in Fig. 2. It consists of a strip of cardboard with a bottom edge marked into 1-in. divisions. Two of these divisions are left clear at the left end, and the alphabet is lettered in, starting with the third division and using one space for each letter. When this is completed, the cardboard is fastened between the uprights against small blocks of wood, the bottom edge with its lettering being ⅜ in. in front of, and ⅜ in. above, the conveyor wire.

Installation of the telegraph can be quickly completed. In the case of the sick boys, I clamped one of the instruments on a table in each room, making sure that each index card faced in the same direction and that the conveyor wires were in line with each other. The transmitting cord was strung between the rooms and threaded through the proper holes, a weight being fastened at each end. In this case the weights were ordinary sash weights. Since one was lighter than the other, a spot of lead was added to give balance.

AFTER the cord was stretched, the index blocks were fastened with the aid of a helper. The index block on one instrument was tightened against the transmitting cord and so held that its pointer indicated the letter A on the index. Then the second block was fastened to point at A, and the apparatus was ready for use.

In operating the telegraph, the boys wiggled the pointer to indicate that a message was ready, then transmitted it letter by letter, using the same wiggling motion to mark spaces between words. In time, they developed great speed and discovered they could transmit more quickly on the string telegraph than on a regular telegraph circuit using the Morse code.

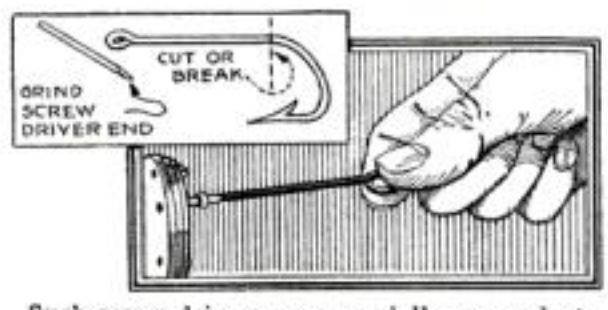
The instruments were first installed in summer, when the transmitting cord was not in the way because it ran through the screen and the windows were open day and night. When winter came—the boys were still using the machine although they had long since recovered—I installed short lengths of small copper pipe through the lower part of the window frames to carry the cord outside.

The success of this original device led to requests for similar apparatus from the dairy and foundry. For these I built instruments in which the index block ran on pulleys between wood guides rather than on the wire conveyors, and the weights were heavy lead blocks. The index cards were much lengthened and carried not only the alphabet but figures from 0 to 9, special symbols used in both businesses, and abbreviations for common words such as "and," "with," and "without."

I left a blank space between each five index divisions to more quickly indicate the end of words, and included punctuation marks at each end of the index. In the case of the foundry, the length of the transmission cord made small supporting pulleys necessary at intervals of about 30 ft.

The instruments for the farm were similar, except that small bells (cast-offs from old typewriters) were fastened just to the left of the letter A on each machine. A smart tap with the index pointer rang the bell and summoned someone to take the message.

MAKING FISHHOOKS INTO TINY SCREW DRIVERS



Such screw drivers are especially convenient since they can be attached to your key ring.

HAVE you ever found it necessary to take down a dollar watch to learn just what was the matter with it or had to do some other equally delicate work only to discover that you lacked a screw driver small enough for the tiny screws? Small screw drivers can be made in an emergency of this kind merely by cutting off the hook part of a fishhook and flattening out the cut end of the shank to form a screw driver blade.

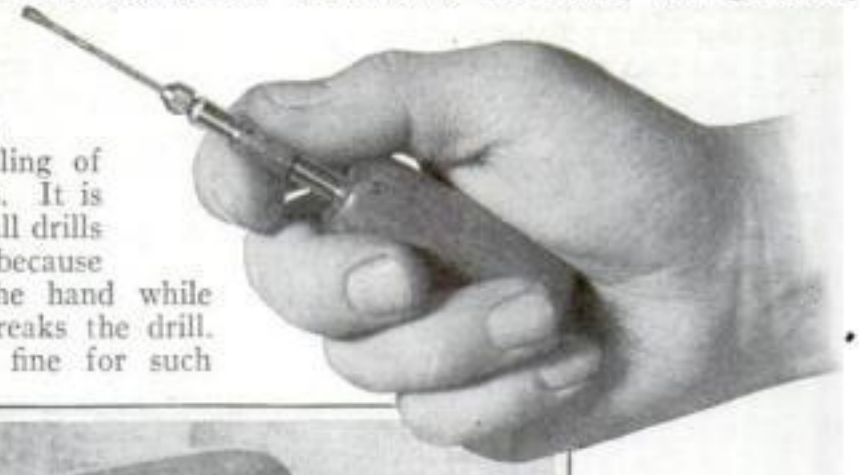
As there are many sizes of fishhooks, you can always choose one to suit the work you wish to do.—FRED CORNELIUS.

MANY amateur craftsmen, like myself, have been called upon to paint a small article that was needed as soon as possible and have been puzzled as to how to hold it so that all sides could be finished at once without at least one of them being marred by coming in contact with the bench or table. This can be accomplished by making a stand from a very thin board of the length and width of the article to be painted. Drive a needle or pin through each of the corners so that the point projects slightly above the surface. Then, when the article has been partly painted, one of the finished sides can be placed gently on the projecting points, which will not noticeably mar the surface.—W. K.

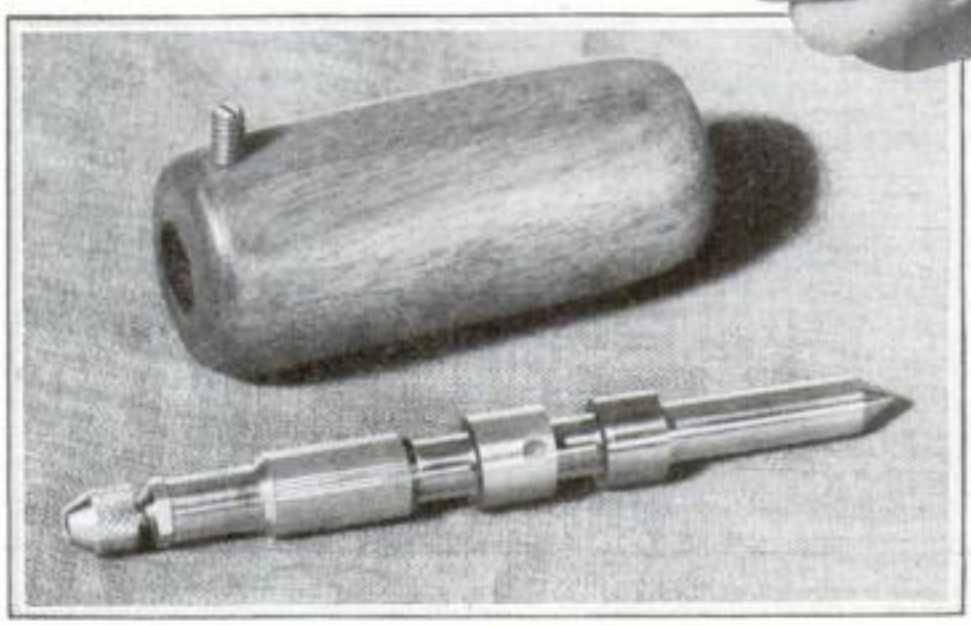
FINGER DRILL AIDS IN MODEL WORK

MODEL making, especially the building of ship models, calls for the drilling of numerous very small holes. It is difficult to handle very small drills in the ordinary hand drill because the slightest twitch of the hand while turning the hand crank breaks the drill.

The tool illustrated is fine for such work, particularly when drilling wood and other soft materials. The handle fits snugly into the palm of the hand and remains stationary while the shaft is rotated by the thumb and first finger applied to the knurled collar.



In use, the handle of this convenient pin vise is gripped in the palm of the hand while the shaft is rotated with the thumb and finger.



The two integral parts that make up the finger drill. A tool such as this will prove valuable to the model maker.

The handle *A* is turned from any suitable hardwood such as birch to the dimensions shown in the drawing. The hole to take the bearings *D* and *B* for the shaft *E* is bored with a ½-in. auger bit. The shaft is made from a piece of ¼-in. drill rod, and any suitable small pin chuck is fitted to one end.

Collars *C* and *F* are turned from drill rod or cold-rolled stock. Make *C* a trifle less than ½ in. in diameter. Drill them with a No. 1 drill and then put a ¼-in. drill through the hole. Unless the drill happens to be a trifle oversize or the drill rod shaft *E* is a bit undersize, this method of drilling will give you a tight press fit so that cross-pinning will not be necessary.

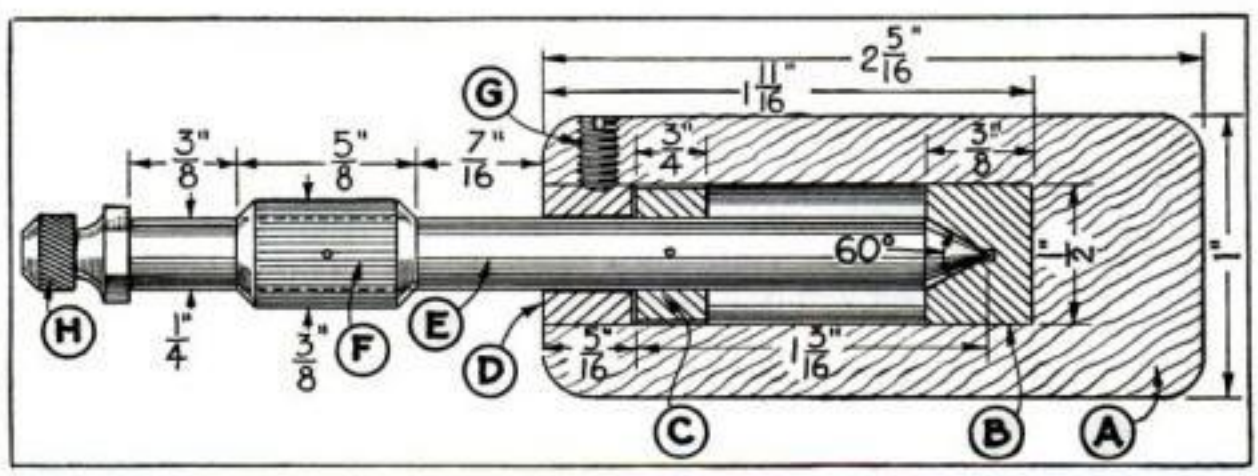
Bearings *D* and *B* are of brass. The hole through *D* should be drilled with the ¼-in. drill, following the No. 1 drill. This will make *D* a running fit on the shaft. The 60° socket in the brass bearing *B* can be cut with a center cutting tool.

The knurling on the collar *F* can be done in the lathe by placing a diamond-point tool sidewise in the tool rest and moving the carriage lengthwise by hand. Rotate the lathe spindle ¼ in., measured on the large pulley, between each cut.

The hole for the set screw *G*, which is cut from an iron machine screw, is drilled with a No. 36 drill and tapped with a 6-32 tap. The threads will hold in hardwood.

Force collar *F* into place or cross-pin it in position, push bearing *B* to the bottom of the hole in the handle, then push bearing *D* into place. Next, push the shaft all the way in and make a scratch on *E* to indicate the position of the bearing *D*. Now press or cross-pin collar *C* in place so that it holds *D* at the scratched line. Oil and assemble the parts.—F. D. R.

AN EASY and effective way to clean tarnished brass, I have found, is to dissolve oxalic acid in water, wet a cloth thoroughly with the solution, dip it in powdered pumice stone, and rub the metal vigorously. Dry with a clean cloth and polish with very fine steel wool or on a buffing wheel.—R. M. HAYES.

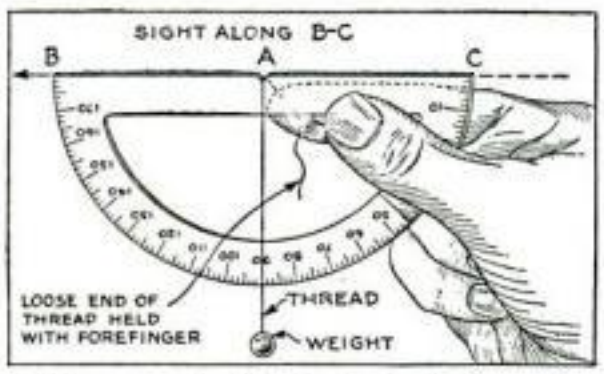


Dimensioned drawing of the finger drill showing the handle in section. The shaft, and the collars *C* and *F*, are of drill rod while brass is used for the bearings *B* and *D* in the handle.

RUNNING LEVELS WITH A PLAIN PROTRACTOR

WITH the addition of a small weight suspended from a thread, an ordinary protractor will serve satisfactorily as a hand level or clinometer for measuring slopes or gradients in degrees. It can be used in leveling fixtures and laying foundations, and also for running small drainage and irrigation ditches and other work where the cost of construction would not justify the employment of an engineer.

File a small notch in the protractor at *A* to receive the thread. In use, the loose end of the thread is held with the right forefinger against the side opposite the scale. Sight along *B* to *C* towards the



When a good sight is obtained, the angle of dip is read along the weighted thread.

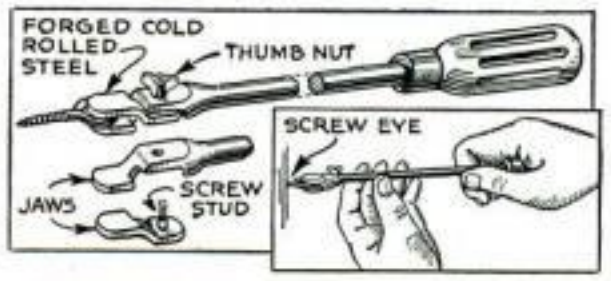
object, press the thread holding the weight against the scale with the thumb of your left hand, and read the degree of dip. In getting the dip of anything at right angles to your line of sight, whether close or far away, hold the protractor at arm's length, scale towards you; then line the edge *B-C* with the object and read the degree of dip.

I have used this method in running geology when I didn't have my instruments. The protractor gave me the dips of rock formations in degrees, and an ordinary pocket compass the strike of the beds.—CHESTER GROW.

HOMEMADE TOOL DRIVES SCREW EYES QUICKLY

WHEN a large number of window screens have to be hung or other work done which requires the driving of numerous screw eyes, it pays to make the special tool illustrated. I have made two different sizes and never again would bother trying to insert screw eyes in the old way with a pair of pliers.

The tool can be made from a piece of cold-rolled steel forged at the end and filed to the shape shown. The jaws are of a simple notched type. It is not necessary to hinge the loose jaw, as the butterfly nut and stud is always in place to hold it.—C. H. W.



A tool such as this is indispensable when a number of screw eyes are to be driven.

CHECKING DECAY OF WOODEN POSTS

POLES and posts sunk in the ground usually begin to rot in a short time. Locust wood, of course, lasts for a great many years, but often it cannot be obtained conveniently. Other woods can be made to endure almost as long by treating them chemically or in various other ways.

One simple method is to dig the hole, place the post in it, and then pour concrete around the wood instead of shoveling the soil back into the hole. The concrete must rise a few inches above the soil, and there should be no depression or concavity in the upper surface of the block in which water can lie and soak into the wood. Posts set in concrete in this way will last a long time, no matter what kind of wood is used and whether it is dressed lumber or tree trunks.

When soaking poles in copper sulphate, fresh solution should be added from time to time.

When posts are freshly cut from trees, they can be treated against rot by placing the bottom of the stems in a large vessel containing a dilute solution of copper sulphate in water. A 3 percent solution is effective; that is, 1 oz. of copper sulphate (bluestone) to 1 qt. of water. In using this method, it is important that the stems should be freshly cut and that the sap in the trunk should not have dried. The stems absorb the blue solution of their own accord, and thus the wood becomes impregnated with copper sulphate, which is a poison for all rot fungi. Fresh copper solution is added from time to time.

Leave the posts from ten days to two weeks, and longer if possible. They may be left, if desired, until the entire wood is tinged with blue; this shows that it has been completely impregnated.

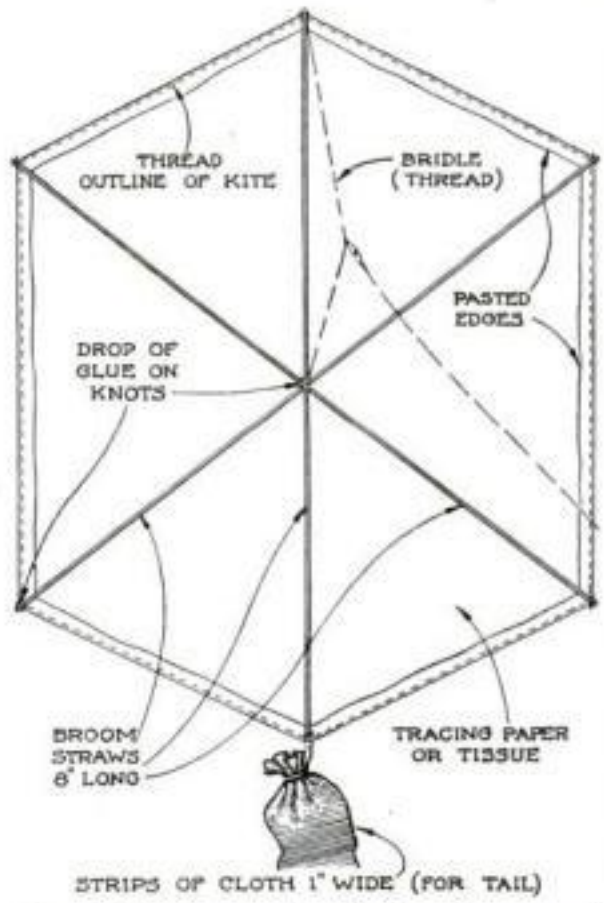
Trunks and dressed lumber in which the sap has dried are treated by other methods. A simple one is to paint the lower part with hot tar or with carbolic acid solution. The latter consists of 1½ oz. of carbolic acid dissolved in 1 qt. of water. When this method is used, be sure that the painted part extends a few inches above the surface of the ground, and do not set the posts in place before they are thoroughly dry. If this precaution is not taken, growing plants near by may be killed.

Another method of treating posts quickly is to place them in a large container of limewater. This is made by placing a handful of burned lime, or lime such as is used for fertilizing the soil, in two or three pails of water. Allow the posts to stand for a few days, then take them out and let them dry. Next paint them with copper sulphate in water —about 2 oz. to 1 qt. of water. This forms calcium sulphate on the wood, which prevents the formation of rot fungus.—H. BADE.

STRAWS SERVE AS FRAME OF MINIATURE KITE

BY USING three straight, stiff broom straws 8 in. long, it is possible to make a miniature tail kite that will fly like a full size one.

The straws are arranged as shown and bound securely at the center with thread. A length of thread is then tied to the ends of the straws to form the outline of the kite. A drop of glue on the center lashing and on each knot will hold all secure.



Three 8-in. straws, thread, glue, tissue, and cloth form the parts of this miniature kite.

Cover the frame with thin tissue or tracing paper, lapping the edges over the string as in making a large kite, and attach the bridle as indicated in the drawing. Tear a piece of cloth into strips about 1 in. wide for making the tail, the length of which will have to be found by experiment. Use light thread for the kite string. If the kite dives, more tail is needed; if it is sluggish or fails to rise in a reasonably strong breeze, the tail is too heavy.—DEWEY W. THOMPSON.

SLEUTHS READ CLUES IN BLOOD

(Continued from page 20)

caused the stains, the tiny halo fails to form.

In the same manner, antichicken, anticat, antideer, and other serums are prepared by injecting these bloods into rabbits. However, these animals cannot produce antirabbit serum because their own blood injected into their veins would not be an irritant.

One suspect, who understood this, told New York City detectives that stains on his clothing resulted from killing Belgian hares. An expert injected hare blood into chickens, produced antirabbit serum, and proved the falsity of his story.

An entirely different method of distinguishing between types of blood has been evolved through a series of researches carried on at the Carnegie Institution of Washington, D. C. Dr. Edward T. Reichert, and his associate, Dr. Amos P. Brown, have found they can tell the blood of different creatures apart and distinguish human blood from that of other animals by the shape and angle of crystals in the red corpuscles.

THE modern, highly trained blood expert can report infallibly when stains have come from human veins. And he can do astonishingly more.

Take this spectacular example. A year or so ago, word raced through the underworld in Chicago that a member of a gun gang had "put the finger on his pals"—had squealed to the police. Two nights later, a watchman found his body lying in an alley. A shot at close range had ripped through the jugular vein. A detective searched the room of a suspect. It yielded a bloodstained shirt. Analysis showed the stains were human blood. The suspect admitted this was true but explained that he had had a violent nosebleed a few days before. His own blood, he said, had stained the shirt.

A generation or so back, this statement might have gone unchecked. But, some twenty-five years ago, scientists made the discovery that the blood of all humans will fall into one of four groups depending upon the arrangement of the molecules. Blood from the suspect fell into Group Two; from the victim into Group Four. And the stains on the shirt front were Group Four blood!

Amazing as such scientific detection is, it is believed it can be carried still further. In cases where the blood groups of both men are the same, if one is suffering from a disease that the other does not have, the germs present in the life fluid of the one and absent from that of the other will distinguish them.

The ultimate aim is to be able to take a drop of blood and identify positively the individual from which it came. What is hailed as an important step in this direction, was recently reported from the University of Koenigsberg, Germany, where Dr. Wilhelm Zangemeister has spent years of studying blood colloids. By noting differences in the amount of light scattered by these ultramicroscopic molecular clumps, he has been able to take blood samples of a number of men and women and, it is claimed, determine which were the parents of a given child. His studies may pave the way to a new technique for the scientific bloodhounds of the law.

BUT germs and colloids are not the only things in spilled blood that aid detectives in unraveling the tangled skeins of a murder mystery.

One of the most dramatic stories told me concerned a bloodstained coat picked up on a river bank north of a large town in New Jersey. As no report of violence or of a missing person had come in, it was at first assumed the stains came from a bloody nose in some minor scuffle. The garment had no identifying markings but as a matter of form it was turned over to the police. At headquarters, an expert examined the stains. Five minutes later, he made the startling announcement that the owner of the coat was dead.

He had found in the dried blood a tiny bone which is situated deep in the skull. A person wounded so severely as to cause the loss of this bone could not live many minutes. Officers searched the vicinity of the river bank. They discovered the hidden body of a murdered racketeer.

IN GERMANY, a few years ago, a somewhat similar clue led to a dramatic capture. Beside the body of a murdered woman, a detective found a tiny piece of flesh with a bit of fingernail attached, caught in a dried bloodstain. The hands of the victim were uninjured, so the sleuth decided the fragment of flesh had been bitten from a finger of the assailant.

Police rounded up four suspects, one with a bandaged hand. When these wrappings were removed, an injured forefinger was found to have a gouged-out place exactly the size of the piece of flesh discovered at the scene of the crime. This blood-borne clue convicted the murderer.

The experts who trail big game in the jungles of the underworld see a thousand and one clues in spots and splotches of blood that the ordinary person misses. To these hawk-eyed man-hunters, the shape of each drop tells its story. If a wounded person is standing still, the falling globules flatten themselves out symmetrically round. But, if the person is moving, the stains are elongated with splashes pointing in the direction of movement.

How much the position of a single drop of blood may suggest to the expert criminal hunter is illustrated by a remarkable St. Louis, Mo., case some years ago. Neighbors found an old woman, who lived alone on the outskirts of the city, robbed and murdered. The unknown slayer had made his escape through a back door.

JUST to the left of this door stood a table covered by a light cloth which fell almost to the floor. In searching for evidence, detectives discovered a single blood spot on the carpet *under* the table where it was hidden by the cloth.

No one could explain how the spot got there. Then it was noticed that every time the door was opened, the breeze blew the hanging part of the cloth back under the table. This led to the deduction that the murderer, in stealing from the scene of his crime, had opened the door with his right hand; the draft had blown back the cloth; a drop of blood had fallen from his left hand, to be hidden as soon as the door closed and the cloth swung back.

This discovery gave two important clues. The murderer was wounded in his *left hand*. And he had committed the crime when the breeze blew from a certain direction, thus enabling a fairly accurate calculation of the time of day. These vital clues, given by a single blood spot, led to the slayer's capture.

NEXT MONTH: How magic rays penetrate crimes! The latest uses of mysterious ultra-violet, X-rays, and polarized light in criminal hunting. Invisible vibrations of the ether wreck the best-laid plans of master crooks. Watch for the next installment of this thrilling series in the October issue of POPULAR SCIENCE MONTHLY.

WHY ASTROLOGY IS A FAKE

(Continued from page 15)

movements of the heavenly bodies; and "judicial astrology," the "art" of discerning their influence on human affairs and of predicting the future from their positions and courses.

It was natural astrology which, much later, especially after the invention of the telescope and other instruments of precision, developed into the science of astronomy. Despite this enormous advance, judicial astrology is still with us, a stubborn survival from the Dark Ages.

TO THE early Babylonian astrologers and to most of their successors in Greece, Arabia, Egypt, Rome, and later in the rest of Europe, the sky was actually a solid dome; the earth was flat and stationary, and the sun and the planets circled around it.

The old Babylonian priests identified the planets with their gods. This practice was taken over by the Greeks and the Romans, which accounts for the names of the five planets known to the ancients—Mercury, Venus, Mars, Jupiter, and Saturn. As a natural consequence, all sorts of powers were ascribed to the planets. At first, these influences were believed to be only of a public nature. The gods (and, therefore, the planets) were responsible for war or peace; droughts or floods; bumper crops or famine; general health or pestilence. Much later, the Greeks of the second and first centuries B. C. developed the idea of the planets' powers over individual lives. They were the inventors of the horoscope.

More than 2,000 years ago, the astrologers divided the zodiac into twelve signs, one for each of its twelve constellations, and attributed certain characteristics and spheres of influence to each sign. For example, one sign was that of the Crab, and because of a crab's peculiar mode of travel, it was once said that a child born under this sign would not "travel straight" through life.

The Zodiac also was identified with the human body. An imaginary giant human figure was stretched, maplike, around the zodiac, with the head in the first sign, that of Aries, the Ram, and the feet in the twelfth sign, that of Pisces, the Fishes. The other main parts and organs of the imaginary body touched the remaining ten signs. In this way, primitive medicine became connected with astrology. The stars and planets were thought to influence the various bodily parts, and all kinds of diseases were blamed on them.

FURTHER, the astrologers divided the sky into twelve "houses"—the houses of life, riches, brethren, parents, children, health, marriage, death, religion, dignities (that is, honors), friends, and enemies. That job done, scarcely anything could happen to a human being that the astrologers could not ascribe to the good or evil influence of some star or planet.

As the planets were identified with the gods, the peculiar characteristics of each god were supposed to be possessed also by his own private planet. For instance, because Mars was the god of war, his namesake, the planet, had jurisdiction over "fire, acids, beasts of prey, burning, poisonous and stinging plants, iron and sulphuric metals." Since blood is shed in war, it was the boss of the blood, too. And because the planet touched the kidney region of the big lad in the zodiacal body-map, it also ruled the kidneys.

A complicated system, but the astrologers had it worked out to a fine point for every planet. With everything thus nicely pigeonholed, it was a comparatively simple matter to predict the future as the heavenly bodies changed their relative positions and "aspects," coming in "conjunction" or "opposition" to one another. While the classifications have been altered from time to time, the framework of this childish jugglery has remained the same.

There you have the real basis of astrology—the superstitions of ignorant, heathen peoples that have been dead these thousands of years. Their gods have been myths for many centuries, and nobody, of course, believes in them anymore. But that has not discouraged the star-gazing charlatans. *They have substituted their own brand of "science" for the powers of the ancient gods. It is this pseudoscience they now palm off on the uninformed as the "foundation" for their chicanery.*

Consider, for example, this statement—a favorite with the present-day radio astrologers:

"No thinking person doubts that the rise and fall of the tides are due to the influences of the sun and moon."

CERTAINLY not. But if the astrologers really believe that it proves that the moon has the power to upset *all* earthly balances, let them take a glass of water out into the bright, silver moonlight, and see how much of a tide is raised in it.

Science can tell the astrologers the exact gravitational effect of the moon on earthly objects. When it is directly overhead, it affects their weight in the ration of *one part in ten million*. If the astrologers have a mind to, they may work this out further. When the moon is overhead, a newborn baby, which otherwise would weigh eight pounds, is lighter by one 78,125th part of one ounce!

No other heavenly body has nearly so great an effect on the weight of things on earth. The sun has half as much as the moon. Venus, which has more than any other planet, has an effect of only one part in 300 billion.

Certainly the powerful planetary influences which astrologers say direct human destinies cannot be vibrations of light. The light which reaches the earth from the moon and the planets is merely weak, reflected sunlight. Nor are these influences electromagnetic. Science has made careful studies and found no measurable electromagnetic effects from the planets.

NEXT consider the possibility of some mysterious, undiscovered vibration from the planets. Their composition is supposed to be more or less similar to that of the earth. If this is the case, the radiations which they would give off would reach the earth in quantities insignificant compared to the same kind of radiations given off by the earth itself. A man standing at the foot of a mountain would probably receive more of these mysterious radiations from the mountain than from the far-away planets. The same would be true of massive buildings.

Clutching at straws of scientific argument, astrologers might claim that the planets do their "work" by intercepting and shutting off radiations that come from other parts of the heavens. But all the planets combined occupy a space amounting to one one-hundred-millionth part of the apparent area of the sky. They have less of a chance of shutting off radiations than gnats, flying in front of a man's face, have of shutting off the sunlight. Even the sun and the moon together could cut off the rays coming to the earth from only one one-hundred-thousandth part of the sky's apparent area!

Scientists do not (Continued on page 113)

FAMOUS SCIENTISTS TELL WHY ASTROLOGY IS A FAKE

(Continued from page 112)

profess to have found out everything there is to learn about the universe. There are forces still being studied and riddles yet to be solved. But no force has yet been suggested that would take the claims of the astrologers out of the class of worthless hokum. Even granting that such a force might be discovered, astrologers still would face this staggering question: If a child's characteristics are formed by "influences" at the time of birth, why don't these characteristics change continually as the "influences" change?

IT IS a difficult matter to pin the astrologers down to a definite explanation of the nature of the mysterious forces with which they deal.

The signs of the zodiac and the constellations they represent no longer coincide. This is due to a phenomenon known as the precession of the equinoxes. When astrology adopted the zodiac, about 2,200 years ago, the sun was in the habit of reaching Aries, the first sign, at the beginning of the natural year, the spring equinox. Today, the equinox occurs almost a month before the sun makes its apparent entry into the constellation of Aries. The signs of the zodiac have slipped a complete cog.

The lad who lies stretched out like a map on the zodiac probably suffers discomfort, for the constellation reserved for his feet is now standing in the sign which rules his head. It will go marching on steadily through all the signs until, in 26,000 years, the ecliptic will have been circled completely.

There are other famous sources of embarrassment. Just as everything was running smoothly, and all the known planets seemed satisfied with their jobs of ruling the mundane affairs the astrologers had assigned to them, the astronomers had to upset the system and discover two more planets—Uranus in 1781, and Neptune in 1846. The painful part was that these two little rascals had been hanging around all the time, exerting "influences" and going through "aspects" which the astrologers hadn't suspected!

A new problem arose as recently as the spring of 1930 with the discovery, at the Lowell Observatory, Flagstaff, Ariz., of still another planet, Pluto (P.S.M., June, '30, p. 27). But as one astrologer said on the radio, this will only serve to make the "science" more nearly accurate, by supplying new data.

The statements found in horoscopes are phrased so as to insure a 50-50 average of hits for the astrologers' guesses. These statements are of two kinds. One class is so general that nearly any normal person may find them applicable. The other class consists of positive statements neatly contradicted by negative ones at some other point in the same horoscope.

PREDICTIONS, too, are made in such veiled and ambiguous terms that it is easy to apply them later to events which actually have occurred. Moreover, there are certain types of happenings which can be foretold positively by anyone. It is child's play to predict "deaths of public characters," "fires," "accidents," and the like, and to disguise them in seemingly definite phrases.

In the general terms employed, anybody can foretell the future. But it is impossible to do so in individual cases. Pretending to base personal predictions on the stars does not give the practice a scientific basis. It is merely a trick which lends the world's oldest come-on game the kind of glamour that always has been and still is required by good business and showmanship.

MAN IS STILL A MONKEY

(Continued from page 34)

to us; and the evidence furnished by the study of the formation and development of unborn creatures. But before we go further into this matter of evidence, let me make something clear to you. It is this: Since Darwin's time—that is, roughly, in the last seventy-five years—so much evidence of the three kinds I mentioned has been gathered, and of several other kinds besides, that now there is a mountain of it. Most of it, by the way, completely vindicates Darwin's views. Personally, I have devoted a lifetime to an examination of this evidence; thirty years, to be exact. Other investigators have done the same thing. The libraries of the world are filled with books on the many ramifications of the subject; some learned men have given their lives to the study of one detail. It stands to reason that all we can do in a talk of this kind is to touch some of the high spots.

MR. MOK: I understand that.

DR. GREGORY: All right. As for the study of unborn creatures, I told you last month that the unborn human baby, in its various stages, presents a blurred record of man's development from the earliest forms. You remember that, in turn, it has characteristics of a one-celled creature, a worm, a fish, an amphibian, a lizard, a hairy mammal, a creature with short legs like an ape and, lastly, a man (P.S.M., July '31, p. 122). It does not begin as a man and end up resembling a fish or a worm, or as a single cell. The evidence in the development of the unborn baby, therefore, supports the evidence of the rocks.

MR. MOK: What does this study show about our monkey descent?

DR. GREGORY: From its beginning as a fertilized egg cell until it is born, a human baby undergoes a series of elaborate changes. Investigations by the late Dr. Emil Selenka, an eminent authority on this subject and others, have shown that similar changes take place in the unborn young of only four other mammals. These are the gorilla, the chimpanzee, the orang-utan, and the gibbon.

MR. MOK: You mean that the human baby and the young of these apes resemble each other in the corresponding stages of their development before birth?

DR. GREGORY: That's it. For instance, if you compare an unborn baby with an unborn young of a chimpanzee or a gorilla in the corresponding stages, you will find them amazingly similar in general appearance. In both cases, for instance, the soles of the feet can be turned toward each other, just like the palms of hands. After birth, the apes retain and develop this feature; as you know, their feet become much more hand-like and grasping. In us, the foot changes so as to support our weight in the upright position; though, as we saw last month, a human baby's foot in still somewhat apelike for a while after birth.

MR. MOK: Will you give me another example?

DR. GREGORY: Here is a striking one: In most of the later half of its life before birth, the human baby's body is covered with short, downy hair. So is that of the unborn ape-young in the corresponding period. Both lose their hair before birth, grow long hair on the head, and are born with hairless bodies. We remain that way, while the young ape soon grows a new coat. So, you see, in this case we retain the pre-natal condition, while the apes retain it in the case of the feet.

MR. MOK: Aren't there any points of difference?

DR. GREGORY: There are, but they are mostly differences in proportion. Curiously enough, the unborn chimpanzee is more human in its proportions than the adult chimpanzee. On the other hand, a child is more apelike in its proportions before birth than after. For instance, compared with a man an adult chimpanzee has longer arms and shorter legs in proportion to the body. This is true, too, when you compare an unborn chimpanzee with an unborn child; but the difference then is much smaller. Before birth, the shape of the chimpanzee's skull also is much more human than in the adult. Now, all these things are regarded by scientists as evidences of relation; that is, common ancestry.

MR. MOK: Are all scientists evolutionists?

DR. GREGORY: Science is a broad field and I am, therefore, unable to answer your question. What I *can* tell you is that all competent authorities on the subject of natural history are evolutionists.

MR. MOK: How do you know?

DR. GREGORY: Because I have never seen any professional paper published by the leading scientific journals of the world in which the broad fact of evolution was questioned for a moment.

MR. MOK: Still, a good many books are published that attack evolution.

DR. GREGORY: Yes, but their authors have no standing in the scientific world. No member of the National Academy of Sciences, of the American Philosophical Society, or of the New York Academy of Sciences is an antievolutionist.

MR. MOK: Surely, membership in those learned societies does not include a share in a monopoly on scientific truth?

DR. GREGORY: No, but it is a guarantee of recognized scientific accomplishment. However, let me ask you a question. If you wanted evidence on any subject, where would you go?

MR. MOK: I should go to an expert.

DR. GREGORY: Yes, but he must be a practical expert. For example, if you want to find out something about the workings of radio, you go to a practical radio man. You don't go to a pastry baker, no matter how skilled and respected, and especially not to one who is known to have an intense dislike of radio. The unfortunate situation in this field is that most people who fight evolution know far less about it, in a practical way, than the young fellows who build their own radio sets know about radio. I have never read any book against evolution which showed that its author was a man, who, if I handed him a fossil bone, could tell me that it was, say, from the left side of the hind foot of a certain dinosaur. A man with the kind of training that would enable him to criticize evolution, would know. Most opponents have little more than a personal dislike of the idea, and a more or less developed talent for argument. But let us get back to our evidence.

MR. MOK: You have told me something of the evidence of the rocks, and that found in the development of unborn children and apes. What of the third kind—structural resemblances?

DR. GREGORY: Their name is legion. Naturally, you have seen for yourself, at the zoo, that the manlike apes outwardly look a good deal like us.

MR. MOK: Distressingly like some of us!

DR. GREGORY: Certainly. That is because they are our poor relations. Have you ever had a chance to watch a mother chimpanzee with her young?

MR. MOK: I have.

DR. GREGORY: (Continued on page 115)

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Then you must have been impressed by her actions. She fondles the young one, pats it on the head, almost kisses it; a rather touching resemblance to the actions of a human mother, which no lower animal shows. But such things are matters of behavior, and that is a different story. As for physical resemblance, that goes much deeper than any number of visits to the zoo could reveal to you.

MR. MOK: Please give me some of the points of similarity.

DR. GREGORY: Here you are: Our skeleton and that of the manlike apes are not only built on the same plan; they actually correspond bone for bone. The only differences are in proportions and posture. They have grasping hands, like ours; they can move their thumbs opposite their other fingers, as we can, though not as freely. They have nails on their fingers and toes, as we have. They have the same number of teeth that we have—thirty-two—if we include the wisdom teeth. They have no outward tail, and neither have we. But they do have a tail remnant, and so have we. They have an appendix, and we have, too. Their females have a single pair of breasts. Then, there is the brain.

MR. MOK: Their brain is not like ours, is it?

DR. GREGORY: It is like ours, only smaller and less developed. We have not a single brain structure that the manlike apes do not possess. Dr. Elliot Smith, of London University, has shown that, while our brain case and brain are larger in proportion, this increase is caused by enlargement of parts that are present in the brain of apes. Because of their manlike brain, the apes, especially the chimpanzee, have a greater learning capacity than any other animal. That is the reason for the amusing performances by trained apes that you have seen in the movies and on the stage. Better than that—they are the only animals that know how to anticipate experience.

MR. MOK: What do you mean by that?

DR. GREGORY: They know how to put two and two together of their own accord. There are many examples of this ability on the part of apes. A chimpanzee belonging to a German zoologist, without being taught the trick, fitted a stick into the hollow end of another to reach a banana. More striking still was the inventive ability of Dohong, the orang-utan at the New York Zoological Park, who used his trapeze as a lever to pry the bars of his cage apart (P.S.M., Feb. '29, p. 147). The senses of the apes, too, resemble ours in sharpness and range.

MR. MOK: Have they been tested?

DR. GREGORY: Yes. They have stereoscopic vision. They can distinguish colors, while lower mammals—for instance, the dog—are known to live in a gray and colorless world. Their hearing, too, is as acute as ours, and they can distinguish between tones almost as well as we can. But aside from the three principal kinds of evidence I have mentioned, there are new kinds. Modern medicine and chemistry have opened fields that were unknown in Darwin's time.

MR. MOK: What have these sciences shown?

DR. GREGORY: The manlike apes are susceptible to the same diseases from which we suffer, particularly typhoid fever. Chimpanzees in captivity have contracted appendicitis, pneumonia, and influenza. They react to stimulants (including alcohol), sedatives, and poisons exactly as we do. They are even plagued by the same parasites!

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MAN IS STILL A MONKEY

(Continued from page 115)

MR. MOK: And what has chemistry brought to light?

DR. GREGORY: It has been used mainly to determine similarity in the blood. According to Sir Arthur Keith, the eminent British naturalist, the blood of the manlike apes and ours is chemically the same to the extent that a small quantity of human blood, injected into the veins of a chimpanzee, is immediately absorbed. This test was actually made. Then it was repeated, but ox blood was used instead of human blood. This was destroyed by the chimpanzee's system, and thrown off through the kidneys. Experiments of this kind, Sir Arthur says, have shown that this particular similarity in the manlike apes amounts to a full 100 percent. In the Old World monkeys, to which we are related, it is ninety-two percent; but in the New World monkeys, which are remote relations of ours, it is only seventy-eight percent.

MR. MOK: How do the manlike apes differ from human beings?

DR. GREGORY: Just as in the case of unborn children and unborn ape-young, the differences in the adults are only differences of degree—that is, of proportion. I have told you about the size of the brain. Our jaws and the bony ridges over our eyes are smaller, but our nose and chin are bigger. Our feet are less handlike, and the hair on our bodies is much smaller in quantity and shorter. Our thumbs are larger, but our toes are smaller, except the big toe. Our canine teeth are much smaller. Two points of difference are striking. First, we have the ability of speech, and the apes have not.

MR. MOK: Can't monkeys talk at all? I understand that they chatter, and that some investigators believe that they have a language.

DR. GREGORY: A good deal has been said about that, but it has never been shown that they have speech in our sense.

MR. MOK: I should think that our ability to talk and to reason might prove that the apes and the monkeys are not related to us, after all.

DR. GREGORY: It proves that no more than the fact that a child is backward proves that it is not the son of its father. They have the same vocal organs that we have. Moreover, experiments have shown that they have at least the beginnings of reasoning power. Sorry if it depresses you, but all we are are *improved and talking monkeys.*

MR. MOK: What is the second striking point of difference?

DR. GREGORY: Our upright position. This has resulted in some changes in our bodily structure. Our spine is bent in a different way. Ours is in the shape of the letter S; that of the apes is bow-shaped. Our head is placed straight on top of our neck; theirs juts forward. Our legs are straighter than theirs, and our pelvis—that is to say, the bony structure of the hips—has become a flat basin on which the organs in the abdomen rest.

MR. MOK: Where did we get our upright position?

DR. GREGORY: We began to acquire it long before we came down out of the trees.

MR. MOK: Did we ever live in trees?

DR. GREGORY: No, but our ape and monkey ancestors did. You were saved from running on all fours by one of them that was a trapeze artist. These humble, ancient ancestors of ours acquired our upright posture for us by climbing. In monkeys that are living today, you can see the various stages that led to our upright position. Some are merely quadrupeds, running on all fours in the trees, like squirrels. Others reach their arms over their heads in climbing. Still others leap from branch to branch, in upright position, like trapeze performers. Those are the clever lads that made real men out of us.

MR. MOK: When and where did we branch off from this ancient ape and monkey ancestral stock?

DR. GREGORY: There are several opinions on these points. You see, in this business of man's descent, there are two distinct kinds of conclusions. One group is based on the evidence of our origin from lower animals that I have told you about. All properly qualified zoological experts agree on four points: First, that man is an animal, no matter what else he may be; second, that he is a backboned animal; third, that he is a member of the Order of Primates; and, fourth, that he belongs to the great branch of the Primates known as the Old World Division. So far, all is agreement. Now come the points where there is room for various interpretations and much need for further light through future research and discovery. These mainly concern the question as to when and where man was freed from the old ape stock.

MR. MOK: But if you scientists are still quarreling, how do you expect to convince us laymen?

DR. GREGORY: I don't expect to convince anybody. All I have been trying to do is to show you some of the things that have convinced *me.*

MR. MOK: What is your personal conviction as to the line of descent?

DR. GREGORY: These are the approximate steps: At the top is modern man. Below him stands the Australian bushman, who carries us back to the Stone Age. Below the bushman come the several fossil species of primitive men that have been found in Europe and Asia. The oldest of these goes back to the beginning of the Ice Age, a million or more years ago. Lower still stand the twenty-odd species of fossil apes from the latter part of the Age of Mammals. Below them come the Old World monkeys from the earlier half of the Age of Mammals. Before them comes the spectral tarsier, a strange, monkey-like creature with big eyes that still lives in Borneo and the Philippines. Below the tarsier is the stage of the lemurs, represented today by their descendants in Madagascar, India, and Africa. Finally come the tree shrews from the latter part of the Age of Reptiles. These are the stages nearest the direct line as yet discovered.

MR. MOK: When did our ancestors learn to walk on their hind legs?

DR. GREGORY: When they left the trees to try their luck at hunting on the plains. This probably happened even before the Great Ice Age.

MR. MOK: Was that the type of creature that is known as the "missing link?"

DR. GREGORY: I don't know. The trouble today is that there are *too many links.* But I will tell you about that in our next talk.

WHERE did the first real man come from? How long has he been here? How did he develop from a half-ape into a brutish, cave-living, club-swinging human being and then into civilized man? The latest answers of Science to these and many other questions will be given by Dr. Gregory next month in his fascinating, human, understandable manner. On the news stands September 1.

HOW THE WORLD LOOKS TO A FISH

(Continued from page 53)

water and air—its path continues to be a straight line if it strikes the surface where the two mediums meet at right angles to its line of travel. When the sun is directly overhead, for example, the rays striking the unruffled surface of a pond would continue down through the water to the bottom in the same straight line.

However, when a light ray strikes the dividing surface between the mediums at an angle, the path of the light ray is changed an amount which depends on the sharpness of the angle at which the ray strikes the dividing surface and upon the relative density of the two mediums. The change in the path of light rays that strike water at an angle is, therefore, quite large because air is so much lighter than water. This change in the path of the light rays is called refraction.

AS THE angle becomes farther and farther from a right angle, a point is reached where the light ray does not pass through from the first medium to the second. Instead it is reflected back into the first medium at the same angle. This is called reflection. The change from refraction to reflection takes place when the light ray comes to an angle roughly halfway between vertical and horizontal.

With these facts in mind, you can see for yourself why the fish gets such a funny view of a fisherman wading in the water. The diagram on page fifty shows a side view of the tank, the fisherman, and the fish, the latter being drawn in at the point where the camera lens was when the picture was taken.

The light that goes through the water from the fisherman's legs direct to the fish's eye forms the true image of the legs at the bottom of the picture. Light also is being reflected from the legs upward toward the surface of the water in front of the fisherman. This light is reflected by the water surface to form the inverted image of the legs.

Light also is coming from the portion of the fisherman's body above the water, and as this portion of the light strikes the water above the fish at such an angle that it penetrates instead of being reflected, the fish sees the refracted image of the fisherman's body and legs.

OF COURSE it is obvious that this peculiar scene as viewed by the fish is possible only when the surface is absolutely calm. If the surface were rough, the fish would see only the true image of the legs with the upper section a mass of dancing shadows.

The workings of this law of optics in the fish's world are of considerable interest and value to fishermen. Their application to practical fishing are clearly explained by Edward Ringwood Hewitt in his book *The Secrets of the Salmon,* to whom the present writer is indebted for turning his attention to this interesting problem and the experiments which visualized the fish-eye views.

VICTIM'S LOST BLOOD IS PUT BACK IN VEINS

WHEN a San Francisco victim of an auto accident lay near death from loss of blood, a "transfusion" with his own blood saved his life. Details of the operation were reported recently to the American Medical Association. The victim had suffered a severed blood vessel, from which blood flowed into his chest. Surgeons recovered the blood, filtered it, and pumped it back into a vein in his arm. He recovered.

MIDGET FARMERS BEAT HARD TIMES

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as to soils, crops, and methods of cultivation and planting.

The Los Angeles County Regional Planning Commission made a study of more than a dozen districts in Los Angeles and Orange Counties, to find and map those areas in towns and in cities or their suburbs best adapted to the individual development of self-sustaining homes.

In Los Angeles County there are thirty-five towns of 10,000 or more inhabitants. At present 4,850 heads of families are living on miniature farms, virtually all of them being employed in these towns. Approximately 1,200 more such families have similar pay-their-own-way homes in about fifteen other cities and towns of 10,000 or more in the remainder of southern California.

ON ONE acre, at Van Nuys, Los Angeles County, Mr. and Mrs. Sam G. Price have twenty-one bearing walnut trees, six years old. These trees produce between 300 and 400 pounds of nuts a year, selling for $65 to $75. They have 150 laying hens, kept in a twenty-by-sixty-foot space, covered by an open-front, university-type chicken house. The first year, these hens paid for their original cost of $1 each, which was at least twenty-five percent too high, and for their feed.

They have since paid for their feed, supplied all the eggs and chickens eaten in the home, and have paid in cash a little better than $150 a year into the family pocketbook. In addition, every year has seen the Prices selling a minimum of $100 worth of "broilers." From six hen turkeys, a minimum of fifty birds are sold each year. These bring better than $100 more than the cost of their feed.

Averaging the walnuts at $70, this is a cash income every year of $420, or seven percent interest on $6,000. Price's place cost about $4,000. In addition, this family charges off $200 for the chickens, turkeys, and eggs consumed by themselves. Beyond this, they raise all the green food, and some of the dry, that the poultry consumes, and all the fresh and canned vegetables, small fruits, and nuts that the family uses during the year.

Price, who works every day in Van Nuys, has kept an accurate record of the development and costs of this midget farm, and finds that he averages three hours a day, six days a week, in making his yard pay for his home. The $35 a month income from the place, with $10 a month added, covers payments on principal and the interest on the mortgage.

THESE midget farms are not gold mines; there is seldom such a thing as making them pay an income equal to that which the salaried worker receives, but thousands of city-employed are working out a new kind of "one-acre-and-liberty" life, on land that costs less than the equivalent of a city lot and house, which must be paid for out of the salary check, and whose yard can contribute little toward paying for itself.

The survey above mentioned shows that the average family in this group of midget-farmers is between four and five, though some range as high as nine, and others as low as two. As has been said, average size is one "commercial acre." The average cost is $1,500 per acre, dropping to $800 in smaller towns, and rising to $2,000 in close-in sections of larger cities.

Homes on these farms cost from $500 to $600 a room, with the average nearer the former figure than the latter. A total investment of $4,000 *(Continued on page 119)*

MIDGET FARMERS BEAT HARD TIMES

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will provide the worker with a one-acre farm and a five-room house. His original payment, in the great majority of instances, if he has a steady job, will be ten percent of the total, or $400. The remainder can be paid off, including interest on the deferred payments, at $40 a month. There are few, even among the half-acre homes, that do not pay this much or more a year, with an average of twenty to twenty-five hours work a week.

OWNERS of these midget farms range from college and high school professors and instructors to day laborers. Salaries range from $25 to $100 a week, with an average of between $35 and $40, or, say, $2,000 a year. On an investment equivalent to, or somewhat less than, that for a city lot and house, the midget-farmer adds $400 to $600 a year to his income from the production of his land, and still is within transportation range of his job.

If he is an office worker, he gets the benefit of two or three or four hours' work in the open air every day, and he does not need, after the first six months or year, to draw from the pay check to buy himself a home. He pays himself his own rent in the form of savings for the future, while he still can continue his savings from his salary.

Crops produced by the midget-farmers range through everything grown on the largest farm in the country. One man, his wife, and three children earn an average of $950 a year on a half-acre by raising guinea pigs and goldfish, the former for medical research laboratories and hospitals, and the latter for pets and for stocking lakes in parks and on large estates. The goldfish pool also produces thousands of water lilies in season, as well as great sheaves of lotus blossoms, commanding as high as twenty-five to thirty cents a flower from florists.

This midget farm produces all the food of the guinea pigs and a large part of that of the fish, while the family raises all its own fruit and vegetables and keeps a small flock of chickens that supply all the poultry and eggs eaten by the family. The owner is a bookkeeper, and he has kept accurate labor and cost figures. These show that he has spent an average of two and one half hours a day, with six hours on Saturday and one hour (feeding time) on Sunday. Two of the children have averaged an hour a day, each, except Sunday.

THE wife does none of the farm work, and has a woman in to help her at least one day a week and often two. This man, A. C. Perkins, had saved $575 when he bought this half-acre for $950, rather more than the average price. With the exception of the first two months of his occupancy, while his five-room house was being built, he has paid nothing out of his salary of $50 a week toward the cost or upkeep of the property, and he has house and land more than half paid for! When he started, he had had no experience with guinea pigs, goldfish, water lilies, chickens, or any kind of farming.

Hundreds of similar successful cases are on record in the files of the Regional Planning Commission. These show that "specialized farming" of the midget farms pays best, just as it does with larger farms, and they are most successful who are most regular in their hours of work, and who devote as much study to their farms as they do to their jobs in the city. Chickens, turkeys, ducks, geese, and occasional flocks of guinea fowl seem to be the backbone of the food crops, furnishing also the quickest cash return. Small fruits and vegetables come second, with rabbits, for food and fur, next, while there are more than one hundred small farms devoted to unusual production, such as the guinea pigs and goldfish, white rats (for laboratories), bullfrogs, bantam chickens, and pigeons.

The fruit and vegetable growers have developed two new and interesting features in horticulture. The first is the making of two or three trees, berry bushes, or vines grow in the space formerly given to one. The second is the terracing of foot-hill land, which can be bought at comparatively low prices, for the production of avocados, tangerines, table grapes, and grapefruit.

BY PRUNING peach, pear, apricot, and other deciduous fruit trees flat against fences and trellises, two to three adult trees can be grown in the space ordinarily given to one. Production of fruit is increased from twenty-five to thirty percent by this method, due to increased penetration of sunlight.

Rotation of crops, of course, has been reduced to a fine art by these midget-farmers. Four years ago, Professor C. A. Stebbins, with his wife and seven children, bought an acre of bare land near San Fernando, Los Angeles County. Stebbins is a member of a high school faculty. On their one acre, with the work accurately divided among all nine members of the family, they produce all the small fruits and vegetables they eat, and about seventy-five percent of the meats, with all the eggs.

The reservoir for irrigation of this midget farm is also a swimming pool for the family, and was built, along with the poultry houses, rabbit hutches, and lath-house, by the father and two older sons. In fact, everything but the house was constructed by these three, while all their trees, berry bushes, and ornamental shrubs were grown in the lath-house by themselves. Professor Stebbins expressed still another view of the midget farm when he said to the writer:

"Our one-acre farm is strictly a business proposition, and our business in life, as we see it, is giving our large family of boys and girls an environment in which they may have room to expand physically, mentally, and spiritually. We believe that this objective is possible of real achievement only in country living.

"We have found, however, that the midget farm gives space to body and mind in which the child may work or play and develop along free and natural lines. It offers contact with plants and animals that draws out the desirable characteristics of reliability, accuracy, punctuality, patience, and love. Our children have become rural-minded and the excitement of the city has little or no appeal to them. And they are healthy. We have no family doctor, and since we came here, we have paid no doctor's bills."

CIVIC societies hold that the greatest factor in the complete absence of tenement districts and slums in the cities and towns of southern California is this individual and independent movement to the midget farm. Recently, a contest on plans and methods of operation, payment for, and maintenance of, these miniature ranches was held in Los Angeles. In this, Professor Stebbins won first prize, and out of the hundreds of plans and systems submitted, all of them successful, the fact developed that only a few had used horses or mules, plows or harrows, in the preparation and cultivation of their farms.

Average production of these 6,000 small farms in southern California is placed at a minimum of $400 a year, including sales and value of food consumed in the home.

New Steel Comes From Junk Pile

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opportunity to sell at a profit. There was nothing at all that represented a systematic organization.

A tremendous industry had to be created from this chaos. War prices made it profitable to invest staggering amounts of money in equipment—which equipment would in the long run decrease the cost of scrapping. Big business entered the scrap iron field. Economists, technical experts, transportation men, financiers, were recruited. Yards of many acres, equipped with overhead traveling cranes and huge electromagnets, sprang up; great shears began snapping their jaws through the whole side of a steel railroad car at one bite; "skull-crackers" weighing up to six tons were provided to smash up formidable castings; thousands of experts with acetylene torches went the breadth of the country, cutting up buildings, bridges, rails, ships, locomotives, huge boilers; hydraulic baling presses made solid briquettes of borings and shavings; and squeezed cans, punchings, and all sorts of light sheet metal scrap into heavy bales.

ESTABLISHED on a grand scale to meet an emergency, the scrap iron business has, nevertheless, increased since the Armistice. Today it represents an investment of $500,000,000, and a personnel of over 200,000. At the bottom remains the man with the push-cart, offering a few pennies for an old bed, or stove, or what-have-you; at the top is a dealer having a yard of thirteen acres, with private railroad sidings and half a million dollars worth of equipment, and buying and selling scrap at the rate of two million dollars a year. There are over a thousand yards having an annual turnover of upward of 10,000 tons.

Most old iron and steel that is collected is destined to be remelted, but not all. When a building is demolished, for instance, the water and gas pipes may be still in such good condition that with a little cutting, straightening, and rethreading, they may be sold as secondhand pipes. As such they naturally bring a higher price than they would if sold for their metal alone. Girders are usually resold as secondhand material.

Battleship hulls, stripped of armor, have found their way into service as breakwaters.

Old rails, instead of being cut up for remelting, are sometimes rerolled. That is, they are heated at the mills and squeezed under terrific pressure through the rolls into perfect rails of smaller size.

DURING the war Italy bought great quantities of discarded steel axles, which it used instead of billets for rolling into bars. Previous to Italy's demand for this type of scrap the axles had been almost a drug on the market. With the entrance of Italian buying, the price jumped from $10 to $40 a ton, and the axles became one of the most desirable forms of steel.

To get a glimpse of a typical large scrapping plant in operation, I recently paid a visit to the scrap yards of a modern firm in New Jersey. This concern has two yards: one in Jersey City and the other in Newark. The first handles only heavy scrap, such as car wheels, axles, automobile engines, rails, and castings. The second handles thin stampings, oil barrels, automobile bodies, and all sorts of light scrap. Between the two, about 50,000 tons of metal are collected and sent to the mills each year.

I went to the heavy scrap yard first. My ideas of a scrap yard as a "scrappy" place were straightway knocked in the head. Beside the entrance was a small modern office building, facing a garden. The yard itself was scrupulously in order. A few houses for machinery, several railroad cars, a number of huge mounds of carefully assorted railway and automobile scrap; and, overhead, two great electric traveling cranes, each dangling an electromagnet. There were no piles of tangled junk.

As I entered, a truck had come in with a load of mixed automobile parts. In a jiffy one of the cranes maneuvered into position. By large magnetfuls, the scrap from the truck was swung to the ground. In about five minutes the truck had started out for another load. Nine trucks of the company, besides the trucks of smaller dealers from whom it buys scrap, are continuously entering and leaving the plant.

A MAN with an acetylene torch was busily cutting up a huge boiler into sections small enough to be further cut by powerful hydraulic shears. A man at the shears was snipping off bars and plates of steel as if they were match sticks and paper. That is all the preparation of what is known as heavy scrap generally consists of. Pieces of iron or steel over one eighth inch thick may be used directly in the furnace.

At the second yard, however, where light scrap is handled, the function of the dealer is more involved. Scrap consisting of iron or steel thinner than that designated as heavy is worthless in its original condition. If thrown directly into the furnace it would burn like tinder, or else it would first fill the furnace and then melt away to almost nothing. Hence, before such scrap is worth anything it must be crushed into solid bales.

For the reason that through its services worthless material is turned into highly valuable material, the second yard is perhaps more interesting than the first. Into it, in almost a steady stream, come the trucks of local scrap collectors. As it passes up the driveway, each truck is weighed, and payment for the material is made or credited.

An overhead crane was again ready to assist the unloading. Its magnet could lift a flat piece, providing it had sufficient surface, of ten tons. At this job it just grabbed all the odds and ends that could hang together.

The first truck I saw was loaded with automobile mud guards, springs from seats, rims, doors, and gasoline tanks. One wondered what could be done with such a mess. Thumping and shuddering at one side of the yard, two hydraulic presses gave the answer.

Built deep into the ground, each press presented an opening at the surface about a foot wide and five feet long. Into this opening workers scraped mud guards, tanks, springs, everything. When full, a cover rolled forward. Then, with muffled groans and trembling, two plungers, one from below and one from above, simultaneously pushing with tons and tons of pressure, squeezed the wrack into a solid cake. By another manipulation the cake was shoved out, and the press made ready for the next load.

Into the presses went every conceivable form of light scrap; out came blocks of steel, forty percent solid metal, each weighing about 600 pounds. Jumping up like filings when the magnet approached, six or eight of these blocks at a time were lifted and dropped into a railroad car. My guide, a technical graduate, artist, junior member of the firm, example of the high grade of men connected with this comparatively young industry, told me with real enthusiasm that two carloads, or about eighty tons, of fine material for steel making were prepared and sent out each day from this yard.

Another powerful shear was here in operation. When I saw it, the operator was feeding it an automobile chassis, which it bit to pieces without the slightest hesitation. A hydraulic press of different design from those underground was busy squeezing up large oil barrels, three at a clip.

"Tin" cans, which are really made of tinned sheet iron, are, in their original state, poison to steel furnaces. There are now companies that do nothing but de-tin such cans—recovering the tin and selling the cans.

MANUFACTURERS of steel for special purposes often demand a particular kind of scrap. A manufacturer of steel cables for elevators, bridges, and so on, continuously combs the country for scrap steel that has a low phosphorus content. Structural steel is of this type. It may astonish you to know that the cables which suspend the roadways of the new Hudson River bridge at New York City are of steel which was made with fully sixty percent of material selected from the junk heap.

A major problem which is being studied is that of alloy steel scrap, for which at present the fullest market has not been developed. Steel mills, for instance, often refuse automobile scrap, because it contains such metals as chromium, nickel, and copper, which will not readily amalgamate with iron or steel in the furnace, and the inclusion of which results in defective pipe or plate. The Institute of Scrap Iron and Steel has this problem in connection with its plan for the wholesale scrapping of automobiles.

It is estimated that within the next ten years the rate of production of steel in the United States will reach 70,000,000 tons a year. If this steel had to be made entirely from ore it is almost certain that the chief ore deposits of the country would be drained within a generation.

Fortunately, the 750,000,000 tons of steel now in use in the form of buildings, bridges, railroads, machinery, ships, and innumerable smaller articles will help save the issue.

Today, the ingredients of steel are generally half pig iron to half scrap. Unlike wood or stone, steel can be renewed again and again, indefinitely. Returning to the melting pot as soon as it has outlived its usefulness, the discard of yesterday is destined to play a leading part in the creations of tomorrow.

What the Pictures *on* Page 40 Really Are

HERE are the answers to the camera puzzles shown on page forty:

No. 2—Back of an alarm clock.
No. 3—A milk bottle cover.
No. 4—Sliced head of lettuce.
No. 5—A vegetable grater.
No. 6—The end of a whisk broom.
No. 7—Pipe cleaners.
No. 8—Package of paper matches.
No. 9—Pop bottle cap.
No. 10—A ball of twine.
No. 11—Just a slice of bread.
No. 12—A dill pickle.

The FAVOR of the Fair to the Face that's Fit

EYES smiling down—confidently. Eyes smiling up—approvingly . . . into the Face that's Fit. The favor of the fair—and the favor of a World goes to face-fit men!

The smooth-shaven, clear-complexioned men who have found the sure, swift way to face-fitness in Williams Shaving Service.

It begins with that cool and friendly Williams Shaving Cream. A luxury for the skin as well as a lather for the beard. Quick-acting under the touch of the brush, moist to the last happy stroke of the blade. Rich and thick and amazingly mild. No after-sting, no grease-clogged pores. The snowy-white Williams Shaving Cream leaves your Face in the pink of condition.

Then (that anticipated tingle!) Williams Aqua Velva. Dash on a spanking, sparkling palmful of it, while your face is still moist. Thrill to its tonic touch as it freshens and firms the sleepy tissues. Count on it to help care for the tiny, unseen nicks and cuts . . . to conserve the good-complexion moisture . . . to send you smiling through the day with a face that looks and feels—Fit!

The world favors the Face-Fit man. And the Face-Fit man favors Williams Shaving Service!

Williams Shaving Liquid!

Lather in a very new form. Quick. Mild. Just shake a few drops on your brush, and there you are. Great, too, for a shampoo.

JUST NOTICE THE FINE SKINS OF MEN WHO USE

Williams

SHAVING CREAM — AQUA VELVA

MAIL THIS!

It will show you the way to Face Fitness

THE J. B. WILLIAMS COMPANY, Dept. PS-110, Glastonbury, Conn.
Canadian Address: 3552 St. Patrick St., Montreal

I am anxious to try Williams Shaving Service. Please send me trial sizes of Williams Shaving Cream and Aqua Velva.

To smokers who are HARD-TO-CONVINCE

We like nothing better than to induce a hard-to-convince smoker to switch to Camels for just one day.

For we know that after he has made a real test, it will be mighty hard to lure him away from this famous brand. It's not easy to smoke parched-dry cigarettes once you have known the delights of perfectly conditioned Camels.

After inhaling the cool, soft fragrance of the Camel blend of choice Turkish and mellow Domestic tobaccos protected by the Humidor Pack, your throat protests against the bite and sting and harsh hotness that comes from crumbly, dry tobacco.

No matter where you pick them up, in any land, in any climate, Camels are the same fresh, factory-prime cigarettes.

For the Humidor Pack of moisture-proof Cellophane air-seals all the flavor in and keeps out weather, dust and germs.

This is no mere advertising story. It is a recitation of fact that has made the whole country conscious of a new superiority in Camels.

If you are hard to convince, won't you switch to Camels for just one day? Then leave them —if you can.

● *Don't remove the moisture-proof Cellophane from your package of Camels after you open it. The Humidor Pack is protection against sweat, dust and germs. It delivers fresh Camels and keeps them right until you smoke the last one*

CAMELS

NO CIGARETTY AFTER-TASTE